

A HANDBOOK OF PLANT SOCIOLOGY

PART II

FOR

B.Sc. AND M.Sc. STUDENTS.

By

MOSES EZEKIEL

PROFESSOR OF BOTANY, WILSON COLLEGE, BOMBAY.

THE POPULAR BOOK DEPOT,
LAMINGTON ROAD,

BOMBAY NO. 7.

1947

Price Rs. 6.

FIRST PUBLISHED IN 1947

Printed by J. J. Khambatta at *The Jam-e-Jamshed* Printing Press, Ballard House, Mangalore Street, Fort, Bombay, and Published by G. R. Bhatkal, for the Popular Book Depot, Lamington Road, Bombay, No. 7.

PREFACE

These are my notes drawn for the use of my B.Sc. and M.Sc. students during the last quarter of a century. It will be obvious that I have borrowed freely from the work of my teachers, colleagues, pupils and friends. To all of them I owe a deep debt of gratitude. I have added some chapters of information collected by myself during my wanderings for the study of plants. None of the lists can be said to be complete. They are tentative. It is hoped they will serve the purpose for which they now go to the press viz. to help the student in his field-work. This aspect of Botany has been very much neglected in the past, but is now coming into its own.

The first part of this book is expected to be out in a year—of course, if the paper control order and the riots do not interfere with the printing. It will contain the theoretical aspect of the subject which is found in most foreign text-books. It will, therefore, be necessarily brief. A small book on “Floral Ecology” with a chapter on “Fruit Ecology” is also ready for the press, but paper and printing difficulties are holding up the publication.

In giving examples of Sociological Groups, I have confined my lists to plants of the Bombay Presidency, with occasional examples from Father Blatter’s revision of the Flora. To my old teachers Prof. Hate and Father Blatter I owe so much that it is difficult to express my gratitude adequately. My best thanks are also due to my friends Dr. T. S. Sabnis and Mr. Charles McCann and my friends and pupils Dr. F. R. Bharucha, Mr. M. S. Khan and Prof. A. N. Namjoshi, and many others who have co-operated in many ways.

All sources of information are acknowledged, but if by accident some have been omitted, the authors will kindly bear with me. I have no intention of belittling their authorship. I gratefully acknowledge all. A list of the sources has been attached at the end.

A word of thanks is due to the authorities of the *Jam-e-Jamshed* Press for undertaking to print the book under difficult circumstances and to my friend Mr. H. S. Dolikuka for many kindnesses. The work has been much delayed owing to the riots and the paper control order.

Wilson College,
Bombay No. 7,
25th March 1947. }

MOSES EZEKIEL

CONTENTS

CHAPTER	PAGE
I. Ecological Classification of Plants. (Warming)	1
II. Biological Classification of Hydrophytes. (Agnes Arber)	2
III. Natural Orders and Genera of Water Plants in the Bombay Presidency	5
IV. Aquatic and semi-aquatic Grasses and salt-water marsh Grasses. A list from Blatter and McCann	8
V. Systematic List of Water Plants and Marsh Plants. (Calder and Biswas)	10
VI. Halophytes in India. (a) Mangroves. (b) Mud-flat Plants. (c) Sand-Binders on the sea-shore	16
VII. Common Petrophytes in Bombay and its neighbourhood	20
VIII. Succulent Plants. (a) Form and mode of life. (b) Genera and species found in the Bombay Presidency	22
IX. Typical Forest Trees found in the Deccan and Konkan Tracts	32
X. Natural Orders having Climbing Plants ..	36
XI. Orders and Genera of Parasitic Flowering Plants	37
XII. Estuarial Flora of the Godaveri. (J. B. Nat. Hist. Soc.)	39
XIII. Desert Flora. (A small list)	40

XIV. Helophytes.—Common Marsh-Plants found in the Bombay Presidency	41
XV. Giant Climbers and other Trees. (a) Trees and Shrubs for swampy situations. (b) Trees for arid situations. (c) Shrubs for arid regions. (d) Plants suited for hedges	43
XVI. Plants of Northern Gujerat. (Saxton and Sedgwick)	46
XVII. Ecology of the Chattershinghee Forest Area. M. Ezekiel	56
XVIII. Classification of Forest Types. (Trewar and Champion)	59
XIX. Forest Vegetation of India. (R. S. Troup) ..	72
XX. Flora of Aden. Blatter (J. B. Nat. Hist. Soc.)	91
XXI. Some Wild Fodder Plants of the Bombay Presidency. By Burns, Kulkerny, Han- mante and others	99
XXII. Character and Distribution of Forests in India. By E. P. Stebbing	100
XXIII. Vegetation of the Kanakeshwar Hill-Tract. A. N. Namjoshi.. ..	123
XXIV. Vegetation of Walls. (Excerpts From a paper by Dr. F. R. Bharucha and Mr. M. S. Khan)	128
XXV. Poisonous Plants of Bombay. Lt.-Col. K. R. Kirtikar	136
XXVI. Plants of the Berar Circle. By D. O. Witt..	137
XXVII. Vegetation of Sind. By H. M. Birdwood. Trees and Shrubs of Lonaola and Karla Groves	148
XXVIII. Flora of Cutch. Father Blatter. (J. B. Nat. Soc.)	151

CHAPTER	PAGE
XXIX. Odoriferous Grasses. By Mrs. Lisboa. (J. Nat. Hist. Soc.)	171
XXX. Flora of Sind. By Dr. T. S. Sabnis. (J. Ind. Bot. Soc.)	173
XXXI. Plants of the Indian Desert. By Dr. T. S. Sabnis	189
XXXII. Epiphytes, Saprophytes and Commensals ..	196
XXXIII. Climbing Plants	201
XXXIV. Draught Resistant Plants in the Deccan. By R. K. Bhide. (Jour. Ind. Bot. Soc.) ..	203
XXXV. Weeds of Rice Fields in the Kolaba District. By M. Ezekiel. (Agr. Coll. Mag. Reprint)	205
XXXVI. Flora of the Indus Delta and the Sundri- buns. By Father Blatter and C. McCann. J. In. Bot. Soc.)	211
XXXVII. Mangroves of India. Blatter and McCann..	232



CHAPTER I

ECOLOGICAL CLASSIFICATION OF PLANTS

A. The soil (in the widest sense) is very wet, and abundant water is available to the plant, the Formations are therefore more or less Hydrophyllous:—

Class I Hydrophytes (Of Formations in Water).

Class II Helophytes (Of Formations in Marshes).

B. The soil is physiologically Dry, contains water which is available to the plants only to a slight extent: the Formations are therefore essentially composed of xerophyllous species:—

Class III Oxylophytes (Of Formations on sour soil).

Class IV Psychrophytes (Of Formations on cold soil).

Class V Halophytes (Of Formations on saline soil).

C. The soil is physically dry, and its slight power of retaining water determines the vegetation, the climate being of secondary importance; the Formations are therefore likewise xerophyllous.

Class VI Lithophytes (Of Formations on rocks).

Class VII Psammophytes (Of Formations on sand and gravel).

Class VIII Chersophytes (Of Formations on waste land).

D. The climate is very dry and decides the character of the vegetation.

The properties of the soil are determined by climate. The Formations are also Xerophyllous.

Class IX Eremophytes (Formations on desert and steppe).

Class X Psyllophytes (Formations on Savannah).

Class XI Sclerophyllous Formations (Bush and Forest).

E. The soil is physically or physiologically dry.

Class XII. Coniferous Formations (Forest).

F. Soil and climate favour the development of mesophilous Formations.

Class XIII Mesophytes.

Note:—Steppe:—A wide treeless plain of grassland (Schimper)
Savannah:—Xerophyllous grassland containing isolated trees.

CHAPTER II

BIOLOGICAL CLASSIFICATION OF HYDROPHYTES

I. Plants rooted in the soil.

A. Plants which are essentially terrestrial, but which are capable of living as submerged water plants, though without marked adaptation of the leaves to aquatic life.

e.g. *Achillea ptarmica*. L.

Cuscuta alba J. & C.

Glechoma hederacea. L.

B. Plants which are sometimes terrestrial, but sometimes produce submerged leaves differing markedly from the air type. The air leaves are associated with the flowering stage. e.g. Certain Umbelliferae, such as *Sium latifolium* L.

C, Plants which produce three types of leaf, (a) submerged, (b) floating and (c) aerial, according to the conditions—internal or environmental.

- (i) Plants in which the aerial type of leaf is generally associated with the flowering stage.

e.g. Many Alismaceae, such as *Sagittaria sagittifolia* L.

- (ii) Plants in which **floating** types of leaf is generally associated with the flowering stage.

e.g. *Nymphaea lutea* L. (Yellow Water Lily).

Castalia alba. Green. (White Water Lily).

Various Batrachian Ranunculi.

Callitriche verna, L.

Potamogeton natans L.

D. Plants which may, in certain cases, occur as land forms but are normally submerged and are characterized by a creeping axis bearing long, branching leafy shoots with no floating leaves, or by a plexus of leafy, rooting shoots without a creeping rhizome.

- (i) Leafy aerial shoots produced at the flowering period.

e.g. *Myriophyllum verticillatum* L.

Hippuris vulgaris. L.

- (ii) Inflorescence raised out of the water, but no aerial foliage leaves except in the land forms.

e.g. *Myriophyllum* (*M. verticillatum*).

Hottonia palustris L.

Many *Potamogetons*.

- (iii) Inflorescence submerged, but essential organs **raised** to the surface.

e.g. *Elodea canadensis* Mich.

- (iv) Inflorescence entirely submerged and **pollination** hydrophilous.

e.g. *Naias*,
Zannichelia,
Callitriche autumnalis L,
Halophila.

E. Plants which in some cases may occur as land forms, but which are very commonly submerged, and are characterised by an abbreviated axis from which linear leaves arise.

(i) Inflorescence raised above the water or borne on a land plant.

e.g. *Lobelia Dortmanna*, L.
Littorella lacustris L.
Sagittaria teris Wats.

(ii) Inflorescence sometimes raised above water or sometimes submerged.

e.g. *Subularia aquatica*. L.

F. Plants which are entirely submerged as regards the vegetative organs and which have a thallus. (Morphologically either of root or shoot nature) attached to the substratum. The flowers are aerial.

e.g. *Tristichaceas* and *Podostemaceae*.

II. Plants which are not rooted in the soil, but live unattached in the water.

(A transition between I and II is found in *Stratiotes aloides* which is rooted during part of the year but floats freely during another part. There are also a number of rooted plants, such as *Hottonia palustris* and *Elodea canadensis*, which are capable of living unattached for a considerable period.)

A. Plants with floating leaves or leaf-like shoots. Flowers raised into the air.

(i) Roots *not* penetrating the soil.

e.g. *Hydrocharis Morsus-ranae*. L.

Spirodela polyrhiza, Schleid.

Lemna minor, L.

Lemna gibba, L.

(ii) Rootless.

e.g. *Wolffia*.

B. Plants entirely or partially submerged.

(i) Rooted, but roots *not* penetrating the soil.

Floating shoots, formed at flowering time, which raise the flowers into the air.

e.g. *Lemna trisulca*. L.

(ii) Rootless.

(a) Inflorescence raised out of the water.

Aldrovanda

Utricularia.

(b) Flowers submerged; hydrophilous pollination.

e.g. *Ceratophyllum*, *Hydrilla*.

CHAPTER III

NATURAL ORDERS AND GENRA OF WATER PLANTS IN THE BOMBAY PRESIDENCY

- | | | |
|-------------------|----|---------------------------------|
| 1. Ranunculaceae. | .. | <i>Ranunculus aquatilis</i> . |
| | | <i>Ranunculus sceratus</i> . |
| 2. Cruciferae. | .. | <i>Nasturtium officinalis</i> . |
| 3. Nymphaeaceae. | .. | <i>Nymphaea</i> . |
| | | <i>Nelumbium</i> . |
| 4. Leguminosae. | .. | <i>Neptunia oleracea</i> . |
| | | <i>Aeschynomene</i> 'indica. |
| | | <i>Aeschynomene</i> 'aspera. |

- | | | | |
|------------------------|----|-------------------------------|--|
| 5. Holoragidaceae. | .. | Myriophyllum intermedium. | |
| 6. Elatinaceae. | .. | Bergia ammanoides | |
| | | and other species of Bergia. | |
| 7. Onagraceae. | .. | Jussia, Ludwigia, Trapa. | |
| 8. Lythraceae. | .. | Ammania baccifera and other | |
| | | species. | |
| 9. Gentianaceae. | .. | Limnanthum all species. | |
| 10. Hydrophyllaceae. | .. | Hydrolea zeylanica. | |
| 11. Convolvulaceae. | .. | Ipomea aquatica. | |
| 12. Rhizophoraceae. | .. | Rhizophora many species most- | |
| | | ly salt water plants. | |
| 13. Scrophulariaceae. | .. | Limnophylla polystachya. | |
| | | Bonnaya veronicifolia. | |
| | | Glossostigma spathulatum. | |
| | | Peplidium humifusum. | |
| 14. Lentibulariaceae. | .. | Utricularia—all species. | |
| 15. Chenopodiaceae. | .. | Sueda, | } Mostly salt
water plants
in mud-flats. |
| | | Atriplex, | |
| | | Salicornea, | |
| | | Arthrocnemum, | |
| 16. Polygonaceae. | .. | Polygonum many species. | |
| 17. Podostemaceae. | .. | Lawii, | } All species. |
| | | Griffithella, | |
| | | Hydrobryium, | |
| 18. Cerratophyllaceae. | .. | Cerratophyllum, | } All species. |
| 19. Hydrocharitaceae. | | Hydrilla, | } Are water
plants. |
| | | Lagarosiphon, | |
| | | Vallisneria, | |
| | | Blyxa. | |

- | | |
|---------------------|--|
| 20. Typhaeae. | .. Typha angustata. |
| 21. Pontedariaceae. | .. Pontederia, } All species.
.. Monochoria. |
| 22. Xyridaceae. | .. Xyris. |
| 23. Commelinaceae. | .. Commelina some species. |
| 24. Aroidaceae. | .. Pistia: Cyrtocoryne retropi-
ralis and spiralis. Laginandra
toxicaria. |
| 24. Lemnaceae. | .. Lemna major and minor, an
Wolffia. |
| 25. Alismaceae. | .. Limnophyton, Saggitaria,
Wislizenia, Butomopsis. |
| 26. Eriocaulaceae. | .. Eriocaulon setaceum.
Eriocaulon rivularia. |
| 27. Naidaceae. | .. Aponogeton,
Potamogeton,
Ruppia,
Zannichellia,
Najas. |
| 28. Graminaceae. | .. Hygrophila aristata.
Cyperus Laceyana Jobbi.
Pseudoraphis aspera.
Elytrophorus articulatus.
Isachne' elegans.
Isachne' australis.
Arundo donax.
And many others. |
| 29. Cyperaceae. | .. Cyperus, many species some in
brackish water.
Kyllinga.
Echinochloa.
Scirpus Kysoor. |

CHAPTER IV

AQUATIC AND SEMI-AQUATIC GRASSES

and

SALT WATER MARSH GRASSES

Coix lacryma Jobbi.

Ischemum rugosum.

Saccharum spontaneum.

Andropogon squarrosus Hook.

Vetivera zizynoides of Blatter and Hallberg Banks of rivers
and marshy places.

Andropogon aciculatus. Alibag sandy shore.

Andropogon conkanensis,

Andropogon annulatus,

Paspalum vaginatum,

Paspalum punctatum,

Paspalum geminatum.

} Salt marshes and
sandy shore.

Echinochloa Crus-galli,

Panicum Crus-galli of Cook,

Panicum Myuroides.

} Stagnant pools and marshy
places and lakes.

Panicum interruptum—In Rice fields.

Pseudoraphis aspera. (Submerged in water, leaves and flowers
floating.)

Pennesetum alopecuroids Nees. Sandy soils near streams.

Isachne' elegans. (On the margins of lakes.)

Isachne' australis. (On the margins of lakes.)

Eolachne pulchella. (On the margins of lakes.)

Arundo donax. (On the margins of lakes.)
Heliochloa schoenoides. (Halophytic.)
H. selutosa. (Salt water creeks, Dwarka.)
Trachis muricata. (Sandy ground near the sea.)
Osterdemia Matrella. (Alibag sandy shore.)
 (A shore plant on rocks and in sandy and salt marshes.)
Perotis indica. *P. latifolia* of Cook.
Sporobolus diander. (Moist places.)
Sporobolus virginicus. (Sea shore plant.)
Sporobolus glaucifolius. (Salt sandy lands.)
Sporobolus orientalis. (Salt sandy lands.)
Eragrostis aspera. (Common in watery places.)
Eragrostis ciliaris. Linn. (Sandy shore.)
Eragrostis inturrupta. (Banks of lakes and streams.)
Eragrostis inturrupta uniloides (Wet places.) *Syn amabilis*
 of Cook.

Eragrostis gangeticus. (Brakish water).
Eragrostis major (of Cook)—Brakish water).
Eragrostis bifaria (Sandy and rocky ground near Poona.)
Halopyrum mucronatum, Stapf. (Halophytic in sand.)
Diplachne' fusca. (Halophytic in sand.)
Chloris quenquesetica Bhide' (Semi-salt lands.)
Eleusine flagelliformis. (Sandy plains of Sind.)
Dactyloctenium scindicum Bois. (Sandy plains of Sind.)
Hydrorhiza aristata. (Floating Grass). Very common in
 Kolaba and Thana Districts.

Homalocenchrus hexandrus O. Kunth.
 (*Learsia hexandra* of Cook.)
Oryza coerectata, Roxb. (Sandy places in salt water).
Elytrophorus articulatus Beauv. (In water courses and Rice
 lands.)
Eleuopus repens Dsf. (Salt lands near the sea.)

CHAPTER V

SYSTEMATIC LIST OF WATER PLANTS
and
MARSH PLANTS AS GIVEN IN BISWAS AND CALDER

Ranunculaceae.	Ranunculus scleratus.
Nymphaeaceae.	Nymphaea lotus. rubra, osculentus. tus. N. stellata. N. cyaneae. Euryale ferox. N. Nelumbium speciosum.
Leguminosae.	Sesbania paludosa. Æschenomenae indica. Æschenomenae aspera. Neptunia oleracea.
Droseraceae.	Aldrovanda vesiculosa.
Holoragidaceae.	Myriophyllum tuberosum. Myriophyllum indicum. Serpicula indica.
Onagraceae.	Jussia repens. Jussia suffruticosa. Trapa bispinosa, var indica and bicornis. Trapa natans. Trapa Maximovicksii.
Umbelliferae.	Cenanthe benghalensis.
Compositae.	Enhydra fluctuans.

Gentianaceae.

Limnanthemum cristatum.
Limnanthemum indicum.
Limnanthemum aurantianum.
Limnanthemum parviflorum.

Hydrophyllaceae.

Hydrolea zeylanica.

Convolvulaceae.

Ipomea aquatica.

Scrophulariaceae.

Limnophilla Roxburghii.
Limnophilla polyantha.
Limnophilla diffusa.
Limnophilla conferta.
Limnophilla hypericifolia.
Limnophilla micrantha.
Limnophilla grattissima.
Limnophilla cana.
Limnophilla heterophylla.
Limnophilla racemosa.
Herpestris Monniera.
Dopatrium nudicaule.
Dopatrium junceum.
Dopatrium lobeliodes.
Bythophyton indicum.

Lentibulariaceae.

Utricularia stellaris,
Utricularia stellaris var inflexa.
Utricularia flexuosa.
Utricularia exoleta.
Utricularia reticulata. (All species).
Utricularia scandens.
Utricularia hirta; bifida, Wallichiana.
Utricularia racemosa.

Acanthaceae.

Cardanthera uliginosa.
Cardanthera triflora.

Amarantaceae.

Hygrophila polysperma.

Hygrophila spinosa.

Alternanthera sessilis.

Amarantus species are often in puddles.

Chenopodiaceae.

Sueda nudiflora and *maritima.*

Atriplex Stocksii.

Arthrocnemum indicum.

Salicornia brachiata.

Polygonaceae.

Polygonum orientale.

Polygonum tomentosum.

Polygonum limbatum.

Polygonum lanigerum.

Polygonum minor.

Polygonum serratum.

Polygonum flaccidum.

Rumex maritimus.

Podostemaceae.

Podostemon Wallichii.

Ceratophyllaceae.

Ceratophyllum demersum.

Hydrocharitaceae.

Hydrilla verticillata.

Lagerosiphon Roxburghii.

Vallisneria spiralis.

Blyxa Roxburghii.

Blyxa griffithii.

Blyxa echinosperma.

Blyxa orizitorum.

Ottelia alismoides.

Hydrocharis cellulosa.

Halophilla ovata.

Scitamineae.

Alpinia allughas.

Pontederiaceae.

Monochoria hastifolia.

- Monochoria vaginalis.
 Monochoria vaginalis var. plan-
 taginea.
 Echornea speciosa (crassipes.)
 Xyridaceae.
 Xyrris indica.
 Xyrris paucifolia.
 Commelinaceae.
 Commelina salicifolia.
 Anilima Hamiltonianum.
 Juncaceae.
 Juncus prismatocarpus.
 Palmaceae.
 Nipa fruticans. } Salt water.
 Foenix palludosa. }
 Typhaceae.
 Typha elephantina.
 Typha angustata.
 Aroidae.
 Pistia stratiotes.
 Cryptocoryne ciliata.
 Cryptocoryne retorspiralis.
 Lagenandra toxicaria.
 Colocasia antiquorum.
 Lasia heterophylla.
 Acorus calamus.
 Lemnaceae.
 Lemna paniculostata.
 Lemna minor.
 Lemna trisulca.
 Lemna polyrrhiza.
 Wolffia arrhiza.
 Alismaceae.
 Alisma plantago.
 Alisma reniforme.
 Alisma oligococcum.
 Limnophyton obtusifolium.
 Sagittaria sagittifolia.
 Sagittaria guayanensis.

Naiadaceae.

Wisneria triandra.
Butomopsis umbellatus.
Butomopsis lanceolatus.
Limnocharis flava.

Aponogeton monostachya.
Aponogeton echinatum.
Aponogeton crispum.
Potamogeton indicus.
Potamogeton crispus.
Potamogeton pectinatus.
Ruppia maritima.
Zanichellia palustris.
Najas indica.
Najas minor.
Najas foveolatus.
Najas graminea.

Eriocaulaceae.

Eriocaulon Sieboldianum.
Eriocaulon quinquaingulare.
Eriocaulon trilobum.

Cyperaceae.

Cyperus cephalotus.
Cyperus distans.
Cyperus tagitiformis.
Cyperus ealtatus.
Eleocharis plantaginea.
Eleocharis fistulosa.
Eleocharis capitata.
Eleocharis palustris.
Scirpus articulatus.
Scirpus squarosus.

Graminae.

Choëmiraphis spinescens.
Choëmiraphis gracilis.
Panicum fluitans.

Oriza.

Panicum muticum.
Panicum myurus.
Panicum inturruptum.
Panicum proliferum.
Panicum flavescens.

Oriza sativa.
Leersia hexandra.
Aristata.
Coix aquatica.
Phragmites karka.

WATER PLANTS

CRYPTOGAMS

Polypodiaceae. *Ceratopteris thalictroides*,
Achrostichum aureum,

Hydropteridae. **Salviniaceae.** *Salvinia natans* and *cucullata*
Azolla pinnata.

Marciliaceae. *Marcilia quadrifida*.

Isoetaceae. *Isoetes coromandeliana*.

Ricciaceae.—*Riccia fluitans*.

Ricciocarpus natans.

ALGAE

1. **Chlorococcaceae.** *Chlorococcus* and *Microstylis*.
2. **Oscillatoriaceae.**—*Oscillatoria*, *Sprulina*. *Phormidium*.
Lyngbya.
3. **Nostocaceae.** *Nostoc*, *Anabena flos-aquae*.
4. **Rivulariaceae.** *Glychotrichia*.
5. **Chlorophyceae.** *Gonium pectorale*. *Pandorina*.
Volvox.

6. Hydrodictyaceae. *Pediastrum simplex*, *duplex* and *Tetras. Hydrodictyon reticulatum*.
7. Chlorillaceae. *Chlorella vulgaris*.
8. Scenedesmaceae. *Scenidesmus acuminatus*.
and *perfoliatus*.
9. Tribonemataceae. *Tribonema bombayacinum*.
10. Cladophora glomerata. *Pithophora*.
11. Oodogoniaceae. *O. oblongatum*.
12. Voucheriaceae. *V. Sessilis* and *V. ornothocephala*.
13. Zygnemaceae. *Spirogyra* and *Zygnema*.
14. Desmidaceae.
15. Diatomaceae.
16. Characeae. *Nitella mirabilis* and *acuminata*.
Chara zeylanica, *fragilis* and *branchipus*.

CHAPTER VI

HALOPHYTES IN INDIA

MANGROVES.

EASTERN MANGROVES.

STERCULIACEAE.

Heritiera littoralis.

MELIACEAE.

Carapa Molluccansis.

C. obovata.

Rhizophoraceae.

Rhizophora mucronata.

Rhizophora conjugata.

Ceriops Candoleana.

C. Roxburghi.

Kandelia Rhidii.

Bruguira gymnorhiza.

B. erioptera.

Combretaceae.	<i>B. caryophalloides.</i>
Lythraceae.	<i>B. parviflora.</i>
	<i>Carralia interregima.</i>
	<i>Lumnitzera racemosa.</i>
	<i>Sonneratia acida.</i>
	<i>S. apétala.</i>
Myrcenae.	<i>Aegecerus majus.</i>
	<i>A. corniculatus.</i>
Rubiaceae.	<i>Scyphiphora hypsophylloides.</i>
Urbenaceae.	<i>Avicinnia officinalis.</i>
Acanthaceae.	<i>Acanthus ilicifolius.</i>
Palmaceae.	<i>Nipa fruiticans.</i>
Goodeniaceae.	<i>Scaveola Lobelia.</i> } In mud.
	<i>S. Konnigii.</i> }
Euphorbiaceae.	<i>Exoecaria agalocha.</i>

MUD-FLAT PLANTS

TREES

Myrtaceae.	<i>Barringtonia speciosa.</i>
	<i>B. acutangula.</i>
Guttiferae.	<i>Callophyllum inophyllum.</i>
Malvaceae.	<i>Thespesia populnes.</i>

HERBS & SHRUBS

Acanthaceae.	<i>Acanthus ilicifolius.</i>
Chenopodiaceae.	<i>Atriplex Stocksii.</i>
	<i>Arthrocnemum indicum.</i>
	<i>Salicornia bracheata</i> and other species.
	<i>Sueda fruticosa.</i>
	<i>S. nudiflora.</i>
	<i>S. monoica.</i>
	<i>S. maritima.</i>

	Holoxylon recurvum.	} Sind plants.
	H. salicornicum.	
	Salsola foetida.	
Ficoidae.	Sesuvium portulacastrum.	
	Mollugo hirta.	
	M. spargula.	
Compositae.	Blumea amplexicaule.	} Sind plants.
	var, maritimus.	
Boraginaceae.	Heliotropium indicum.	
Convolvulaceae.	Cressa cretica.	
Graminaceae.	Eriochloa polystachia.	
	Sporobolus glaucifolius.	
	Eleuopus littoralis.	
Zygophyllaceae.	Peganum hermala.	

PSAMMOPHYTIC HALOPHYTES. (SAND BINDERS)

Portulacaceae.	Portulaca oleraceae (cosmopolitan).
Leguminosae.	Indigofera cordifolia.
	Crotalaria juncea.
	Sesbania aculeata.
	Tephrosia purpurea.
Geraneacea.	Oxalis corniculata.
Rubiaceae.	Spermacoce' hispida.
Convolvulaceae.	Ipomea biloba.
	Ipomea digitata.
	Evolvulus alsinoides.
Compositae.	Launea nudicaulis.
	Ageratum conyzoides.

	<i>Vernonia cinera.</i>
	<i>Blumea membranacea.</i>
	<i>Eclipta erecta.</i>
<i>Acanthaceae.</i>	<i>Lepidaghatia critata.</i>
<i>Pedaliaceae.</i>	<i>Pedaliu murex.</i>
<i>Labiatae.</i>	<i>Leucas longifolia.</i>
<i>Nyctaginaceae.</i>	<i>Boerhaavia diffusa.</i>
<i>(Asclepiadaceae.</i>	<i>Cryptostegia grandiflora.)</i>
<i>Boraginaceae.</i>	<i>Heliotropium indicum.</i>
	<i>Heliotropium supinum.</i>
<i>Amarantaceae.</i>	<i>Amarantus Blittum.</i>
	<i>Amarantus spinosus.</i>
	<i>Ærua lanata.</i>
<i>Lythraceae.</i>	<i>Ammania baccifera.</i> In moist places.
<i>Solanaceae.</i>	<i>Solanum xanthocarpum.</i>
	<i>Datura stramonium.</i>
<i>(Salvadoraceae.</i>	<i>Salvadora persica.</i>
	<i>Salvadora oleoides. (In Gujerat).</i>
<i>(Guttiferae.</i>	<i>Callophyllum inophyllum.</i>
<i>Malvaceae.</i>	<i>Thespesia populnea.</i>
(These in brackets are always in the background.)	
<i>Malvaceae.</i>	<i>Sida acuta.</i>
	<i>Sida veronicifolia.</i>
	<i>Sida cordifolia.</i>
<i>Euphorbiaceae.</i>	<i>Euphorbia pilulifera.</i>
	<i>Euphorbia thymifolia</i>
	<i>Phyllanthus neruri.</i>

	<i>Phyllanthus madarspatensis.</i>	
	<i>Ricinus communis.</i>	
Pandanaceae.	<i>Pandanus odoratissimus.</i>	} Back gr.
	<i>Pandanus furcatus.</i>	
Liliaceae.	<i>Agave Americana.</i>	} Back gr.
	<i>Chlorophytum tuberosum.</i>	
Graminae.	<i>Eragrostis amabilis.</i>	
	<i>Eragrostis tennela.</i>	
	<i>Cynodon dactylon.</i>	
	<i>Spinifex squerrosus.</i>	
	<i>Diplacne fusca.</i>	
	<i>Ischemum rugosum.</i>	
	<i>Saccharrum spontaneum.</i>	
Cyperaceae.	<i>Scirpus maritimus.</i>	
	<i>Kyllinga trisepts.</i>	

CHAPTER VII

COMMON PETROPHYTES FOUND IN BOMBAY

Menispermaceae.	<i>Cocculus villosus.</i>	
Cappridaceae.	<i>Capparis grandis.</i>	
	<i>Capparis spinosa.</i>	
Lythraceae.	<i>Woodfordia floribunda.</i>	
Rhamnaceae?	<i>Zizyphus jujuba.</i>	
	<i>Zizyphus oenoplea.</i>	
	<i>Scutia indica.</i>	
Burseraceae.	<i>Boswallia serrata.</i>	
Gentianaceae.	<i>Canscora diffusa</i> and	} Shade-loving.
	other species.	

Rubiaceae.	<i>Randia dumetorum</i> . <i>Ixora coccinia</i> and others.
Compositae.	<i>Glossocardia lenearifolia</i> . (Monsoon). <i>Launea pinnatifida</i> . <i>Blumia</i> many species.
Asclepiadaceae.	<i>Sarcostemma brevistigma</i> . <i>Carraluma fimbriata</i> . <i>Callotropis gigantia</i> and <i>procera</i> .
Scrophulariaceae.	<i>Linaria ramossissima</i> . <i>Lindenbergia urticifolia</i> . <i>Celsia coromandeliana</i> .
Plumbaginaceae.	<i>Plumbago zeylanica</i> . (throughout Konkan) & in Dharwar.
Amarantaceae.	<i>Alternanthera triandra</i> . <i>Alternanthera repens</i> .
Euphorbiaceae.	<i>Acalypha indica</i> . <i>Euphorbia nerifolia</i> . <i>Euphorbia tirucalli</i> . <i>Pedilanthus tithymaliodes</i> .
Urticaceae.	<i>Ficus benghalensis</i> and other species.
Liliaceae.	<i>Smilax microphylla</i> and other species.
Tamaricaceae.	<i>Tamarix gallicca</i> . <i>Tamarix dioica</i> and <i>cricoides</i> . (In rocky river beds.)
Graminaceae.	<i>Eragrostis tennela</i> . <i>Arthraxon macrophylla</i> . <i>Aristida adscencionis</i> .
Cyperaceae.	<i>Cyperus</i> may species. (In many rocky river-beds).

CHAPTER VIII

SUCCULENT PLANTS

Form and Mode of Life

Succulents are described popularly as "Juicy Plants". The "Juiciness" may lie in the stem or leaf or both. They are the most specialized of plant forms. They are a living expression of peculiar conditions of soil and climate. Whilst plants in the warm moist tropics and sub-tropics produce a luxuriant growth of leaves, those in the deserts and semi-deserts must conserve water, because of the greatly reduced moisture of air and soil, and of the intense heat and sun-shine. Those plants therefore, which grow in hot rainless situations must possess the power of absorbing quickly the little water at their disposal, and, above all, by reducing transpiration, of retaining it as long as possible. These requirements necessitate a different form and mode of life from that of plants in more favourable circumstances. This is evidenced by the extraordinary variety of forms produce by this ecological group.

These plants are highly adapted for rapid absorption and skillful conservation of the scanty water supply. The methods are varied and extremely efficient. These adaptations, of which one or more may be seen among any one of them, may be classified as follows:—

1. A deep set root-system in order to reach the water-table.
2. A shallow root-system, so as to enable them to quickly absorb the nightly dew.

3. A water-storage tissue is developed in the leaves or shoots or both. These may contain up to 95 per cent of their volume as water. They are obviously very fleshy in appearance.

4. Vesicular hairs filled with water may be present upon the upper surface of the leaves and are a distinct advantage.

5. Reduction of leaf-surface and of the number of leaves.

6. The much reduced leaves are adpressed to the stem. ✓

7. The leaves are fat and fleshy or small and cylindrical or ovate or spherical.

8. The plants are usually completely at rest during the dry period. The leaves and shoots are shrunk or dried up. They are, however, capable of recovering quickly after the first rains, and in short time produce new leaves or show new growth in one form or another.

9. In some, a pair of completely united leaves are formed. These enclose a pair of separate leaves for use during the growing period.

10. The arrangements of the leaves are in the form of a rosette, thus making it possible for the leaves to close together like a bulb under strong sunshine.

11. Some have a coating of whitish or bluish wax, or have white felted or woolly hair, or have a sticky resin. (e.g. Aloe).

12. A large number of succulents are protected by a much thickened outer skin; the epidermis may be many layered with the outer-most layer highly cutinized.

13. The subjacent tissue may be well protected by a heavy deposition of anthocyanine pigments (Red colouring matter). This pigment gives additional protection to the chlorophyll grains beneath the skin.

Plants such as these enumerated above, may have remarkable and often beautiful leaves. They may then be called

"Leaf Succulents". Others among them may be almost or completely leafless. In that case the functions of the leaf, transpiration and photosynthesis are taken over by the green shoots, unless leaves—small or large—are formed during the favourable part of the year, eventually to be shed during the unfavourable period, sometimes called the "Resting Period."

14. Leafless succulents are usually very fleshy. The shoots possess large volumes of water-storage tissue.

15. Whilst the cuticle is greatly thickened, wood and cork development is reduced.

16. Absence of leaves leads to spine formation either in place of the leaves or round about them.

17. It may be taken as a general rule, that the drier the habitat of the plant, the greater is the reduction of the total surface area. It is obvious that great reduction of the transpiring surface and photosynthetic tissue will naturally reduce the beneficial effects of light and profoundly affect the power of assimilation of the plant. The formation of fresh material being small, the growth of succulents is always slow.

18. Certain plants develop "Windows"—a tissue lacking chlorophyll usually at the tips of the leaves. This gives access of light to the assimilating tissue, possibly under all circumstances without thereby foregoing full protection of the transpiration, e.g. *Lithops optica*. Here the leaves are more or less buried in the ground, the "Windows" alone are exposed to light. The penetrating harsh glaring sunlight is mitigated by a layer of calcium exalate crystals in the cuticle and this much diminution in intensity, but still effective, it reaches the chlorophyll layer deep down in the leaf. At the same time light is further reduced by the convex surface of the "Windows" in

Fenestraria and Ophthalmophyllum which reflect the sun's rays like a lens.

Camouflage:—Not only are succulents influenced by the effects of important growth factors but many of the South African species resemble most confusingly, in colour and form the ground in which they grow, so as completely to escape detection. The Lithops closely resemble pebbles around them, whilst Pleiospilos are difficult to distinguish from angular bits of rock. Other plants which occur on calcarious soil like Titanopsis and Crassula mesembrianthemopsis, etc. can hardly be recognised amongst the rough white lime-stone. Some of the Anacamperos . . . resemble the white excrement of birds. All these mimicry forms may be regarded as protection against browsing animals.

SUCCULENT PLANTS

(List of Bombay genera described in H. Jacobson's "Succulent Plants".) 1. Agave. 2. Aloe. 3. Bryophyllum. 4. Carraluma. 5. Ceropigia. 6. Crassula. 7. Euphorbia. 8. Jatropha. 9. Kalanchoe. 10. Moringa. 11. Pedilanthus. 12. Portulaca. 13. Sarcostemma. 14. Sedum. 15. Sempervivum. 16. Senecio. 17. Tradescantia. 18. Zygophyllum.

LIST OF SUCCULENT PLANTS

(Of the Bombay Presidency)

1. Cruciferae:—

1. Moricandra tortuosa—Leaves.
2. Senebeira pinnatifida—Leaves.
3. Pluporhyncus bruhnicus—Leaves.

2. Portulacaceae:—

1. Portulaca. All species—Leaves and stem.
2. Talinum cunifolium—Leaves and stem.

3. **Zygophyllaceae:—**

1. *Zygophyllum simplex*—Leaves and stem.
2. *Zygophyllum coccinium*—Leaves and stem.

4. **Geraniaceae:—**

1. *Impatiens Bedommii*—Leaves.

5. **Vitaceae:—**

1. *Vitis trifolia*—Leaves.
2. *Vitis setosa*—Stem.
3. *Vitis elongata*—Stem.
4. *Vitis quadrangularis, repanda*—Stem.

6. **Crassulaceae:—**

1. *Bryophyllum Calycinum*—Leaves.
2. *Kalanchoi glandulosum*—Leaves.
3. „ *spathulatum*—Leaves.
4. „ *floribunda* var *glabra*—Leaves.
5. „ *Oleracea*—Leaves.
6. „ *Bhideii*—Leaves and stem.
7. „ *laciniata*—Leaves.

7. **Onagraceae:—**

1. *Trapa bispinosa*—Leaves and petioles.

8. **Begomaceae:—**

1. *Begonia Roxburghi*—Leaves and stem.
2. „ *crenata*—Leaves.
3. „ *integrifolia*—Leaves and stem.
4. „ *concanensis*—Leaves and stem.

9. **Ficoidae (Aizoaceae):—**

1. *Sesuvium portulacastrum*—Leaves and stem.
2. *Trianthema, monogyna*—Leaves.
3. „ *triquetra*—Leaves.
4. „ *pentandra* (Sindh)—Leaves and stem.
5. „ *hydaspica* (Sindh)—Leaves and stem.

6. *Orygia decumbens*—Leaves.
7. *Gysekia pharmaceodes*—Leaves and stem.
8. *Tetragonia expansa* (excluded sp.)—Leaves and stem.

10. Rubiaceae:—

1. *Anotis carnosa*—Leaves.
2. *Anotis quadrangularis*—Leaves and stem.

11. Compositae:—

1. *Adenoon indicum*—Leaves.
2. *Pluchia arguta* (Sind)—Stem.
3. *Wedelia calandulacea*—Stem.
4. *Wedelia urticifolia*—Stem.
5. *Artemesia vulgaris*—Leaves and stem.
6. *Artemesia pallens*—Leaves and stem.
7. *Gynura angulosa*—Stem.
8. *Emilia sonchifolia*—Stem.
9. *Notonia grandiflora*—Leaves and stem.
10. *Senecio Dalzelli*—Stem.
11. „ *Grahamii*—Stem.
12. „ *Gibsonii*—Stem.
13. *Caesulia axillaris*—Leaves and stem.
14. *Eclipta erecta*—Leaves and stem.

12. Campanulaceae:—

1. *Sphenoclea zeylanica*—Stem.

13. Goodenaceae:—

1. *Scaveola koenigii*—Leaves and stem.
2. *Scaveola lobelia*—Leaves and stem.

14. Asclepiadaceae:—

1. *Periploca aphylla*—No leaves, stem.
2. *Holostemma Rheedianuno*.
3. *Sarcostemma brevistigma*—No leaves, stem.
4. „ *stocksi*—No leaves, stem.
5. „ *intermedium*—No leaves, stem.

6. *Tylophora tenuis*—Leaves.
7. *Hoya ovalifolia*—Leaves in the whole genus.
8. „ *retusa*.
9. „ *Wightii*.
10. „ *Griffithi*—Not included.
11. „ *carnosa*—Not included.
12. *Leptadenia spartum*—No leaves, stem.
13. *Ceropegia juncea*—Stem.
14. „ *Lawii*—Leaves and stem.
15. „ *bulbosa* var *Lushi*—Leaves and stem.
16. *Ceropegia oculata*—Leaves and stem.
17. *Ceropegia tuberosa*—Stem.
18. *Freria indica*—Leaves and stem.
19. *Leptadenia spartum*—No leaf, stem.
20. *Carralluma fimbriata*—No leaf, stem.
21. *Carralluma edulis*—No leaf, stem.
15. **Plumbaginaceae**:—*Statice stocksii*—Leaves.
(Kathiawar and Sind.)
16. **Salvadoraceae**:—
 1. *Salvadora persica*—Leaves.
 2. *Salvadora oleoedes*—Leaves.
17. **Loganiaceae**:—
 1. *Fragrea obovato*—Leaves.
18. **Hydroleaceae**:—
 1. *Hydrolea zeylanica*—Stem.
19. **Boraginaceae**:—
 1. *Coldenia procumbens* Lim—Stem.
 2. *Heliotropium indicum*—Stem.
20. **Convolvaceae**:—
 1. *Ipomea aquatica*—Stem.
 2. *Ipomea biloba*—Leaves and stem.

3. *Argeria speciosa*—Leaves.

21. **Scrophulariaceae:—**

1. *Schweenfurthia sphaerocarpa*—Leaves.
2. *Moniera cuinifolia*—Leaves and stem.
3. *Limnophila* all species—Leaves and stem.
4. *Dopatrium juncum*—Leaves and stem.
(in swampy places)
5. *Bonnaya veronicifolia*—Stem.

22. **Orobanchaceae:—**

1. *Orobanche* all species—Stem.
2. *Cistanche* all species (particularly *tubulosa*)—Stem.

23. **Acanthaceae:—**

1. *Meyenia Hawtayneana*—Leaves.
2. *Tubiflora acaulis*—Leaves.
3. *Barleria cristata*—Leaves.
4. *Asystasia Lawiana*—Stem.
5. *Eranthemum malabaricum*—Leaves.
6. *Lepidaghatia prostrata*—Stem.
7. *Justicia quinqueangularis*—Stem.
8. *Justicia simplex*—Stem.

24. **Verbenaceae:—**

1. *Lippia nudiflora*—Stem.
2. *Clerodendron inerme*—Leaves.

25. **Labiatae:—**

1. *Anisochilus carnosus*—Leaves.
2. *Anisomelis ovata*—Leaves.
3. *Anisomelis malabaricus*—Very thick leaves.
4. *Leucas lanata*—Leaves.
5. „ *montana*—Leaves.
6. „ *Mollissima*—Stem.
7. „ *stricta*—Stem.

26. Plantaginaceae:—

1. *Plantago ciliata*—Stem.

27. Polygonaceae:—

1. *Rumex dentatus*—Stem red and fleshy.

28. Piperaceae:—

1. *Piper nigrum*—Leaves and stem.
2. „ *Hookerii*—Leaves.
3. „ *subpeltatum*—Leaves.
4. „ *Beetle*—Stem.
5. „ *longum*—Stem.
6. *Peperomia Wightiana*—Leaves and stem.
7. „ *pellucida*—Stem.

29. Myristicaceae:—

1. *Myristica malabarica*—Leaves thin and coriaceous.
2. „ *Beddomii*—Leaves.
3. „ *magnifica*—Leaves.
4. „ *attenuata*—Leaves.

30. Lauraceae:—

1. *Cryptocarya Wightiana*—Leaves coreaceous.
2. *Beilschmiedia fagifolia*—Leaves coreaceous.
var. *Dalzelli*.
3. *Cinnamomum Zeylanicum*—Leaves coreaceous.
4. „ *macrocarpum*—Leaves thin and coreaceous.
5. *Machelus macranthus*—Leaves thin and coreaceous.
6. *Alsiodaphne semicarpifolia*—Leaves thin & coreaceous.
7. *Actinodaphne Hookeri*—Leaves thin and coreaceous.
8. *Litsia* all species.
9. *Cassytha filiformis*—Stem, no leaves.

31. Eleagnaceae:—

1. *Eleagnus latifolia*—Leaves coriaceous.

32. Loranthaceae:—

1. Loranthus all species—Leaves coriaceous.
2. „ cuneatus—Sub-fleshy leaves.
3. Viscum manoiicum—Thinly coriaceous leaves.

33. Santalaceae:—

1. Osyris arborea—Leaves coriaceous.
2. Scleropyrum Wallichianum—Leaves coriaceous.

34. Balanophoraceae:—

1. Balanophora indica—Stem tuberous.

35. Euphorbiaceae:—

1. Euphorbia all species—Leaves and stem.
2. Hemicyclea venusta—Leaves thick.

36. Urticaceae:—

1. Lecanthus—Stem.
2. Elatostemma lincolatum—Stem.
3. Parictaria debilis—Stem fleshy and flacid.

37. Orchidaceae:—Many genera have thick leaves. Some have thickly coreaceous leaves. The following are important:—

1. Leuxine—Thick stem.
2. Cheirostylis—Thick stem.
3. Habenaria platyphylla—Leaves fleshy.
4. „ Heynea—Stem.
5. „ subpubens—Stem.
6. „ crassefolia—Leaves.
7. „ diphylla—Leaves.

38. Amaryllidaceae:—

1. Crinum sp.—Leaves.
2. Agave sp.—Leaves.

39. Liliaceae:—

1. Scilla indica—Leaves.

2. *Dipcadi concanense*—Leaves.

3. *Depcadi montanum*—Leaves.

Excluded species:—

4. *Aloe vera* and *variegata* have thick fleshy leaves with abundant water storage tissue.

40. Gesneraceas:—

1. *Aeschenanthus Perotteti*—Leaves.

2. *Klugia Notoniana*—Stem.

3. *Rhynchoglossum obliquum*—Stem.

4. *Epithema carnosum*—Stem.

41. Pedaliaceae:—

1. *Pedaliium Murex*—Leaves and stem.

Capparidaceae. *Cleome quinqueraria.* Leaves.

Cleome Stocksiana. Leaves.

Resedaedaceae. *Ochrandemus baccatus.* Leaves.

Bixaceae. *Flacourtia latifolia.* Leaves coriaceous.

CHAPTER IX

TYPICAL FOREST TREES FOUND IN THE CONKAN AND DECCAN TRACTS

ANONACEAE.

Unona pannosa.

U. discolor.

Polyalthia fragrans.

P. corasoides.

Gonoithalamus Cadiopeta-
lous.

Milliusa indica.

Sarcopetalum tomentosum

MALVACEAE.

Hibiscus tiliaceus.

Thespesia populnes.

Adansonia digitata.

Bombax malabaricum.

BIXACEAE.

Cochlospermum Gossypium.

GUTTIFERAE.

Garcinia indica.

G. xanthochymus.

STERCULIACEAE.

Sterculia urens.

S. foetida.

TILIACEAE.

Grewia asiatica.

Eliocarpus ganitrus.

RUTACEAE.

Glycosmis pentaphylla.

MELIACEAE.

Azadirachta indica.

Soymeda rebrifuga.

RHAMNACEAE.

Zizyphus jujuba.

Z. xylopyrus.

Z. rugosus.

Scutia indica.

LEGUMINOSAE.

Papilionaceae.

Erythrina indica.

Butea frondosa.

Dalbergia Sissoo.

D. latifolia.

Pongamia glabra.

Caesalpiniae.

Parkinsonia aculeata.

Cassia fistula.

Saraca indica.

Bauhinia Malabarica.

B. purpuria.

Mimosae.

Acacia arabica.

A. concinna.

A. suma.

Acacia Catechu.

Albizzia Lebbeck.

A. amara.

Pithecolobium bigeminum.

COMBRETACEAE.

Terminalia belerica.

T. Chebula.

T. Arjuna.

T. tomentosa.

T. paniculata.

Anoguissus latifolia.

Combretum ovalifolium.

MYRTACEAE.

Eugenia laeta.

E. jambolana.

E. corymbosa.

Barringtonia speciosa.

B. acutangula.

Carea arborea.

LYTHRACEAE.

Legerstroemia flos-regina.

L. parviflora.

L. lanceolata.

Woodfordia floribunda.

RUBIACEAE.

Moessonda frondosa.

Randia dumetorum.

Gardenia lucida.

G. gummifera.
Vanguiria spinosa.

SAPOTACEAE.
Mimusops elengii.
M. hexandra.
Bassia latifolia.
B. longifolia.
Sideroxylon tomentosum.

APOCYNACEAE.
Carrissa carandas.
Cerabera thevetia.
Alstonia scholaris.
Hollarhinna antidyssentrica.
Wrightia tomentosa.
W. tinctoria.
Anodendron paniculatum.

BORAGINACEAE.
Cordia myxa.
C. Rothii.
C. Macleodes.
C. fulvosa.
Ehrctia levis.

BIGNONIACEAE.
Dollichandron falcata.
Heterophragma Roxburghii.
Steriospermum chelonoides.
S. swavelens.
Radermachera xylocarpa.
Pajanella multijuga.
(*Spathodea companulata.*)
Kigelia pinnata.

VERBENACEAE.
Callicarpa lanata.
Tectona grandis.
Gmelina arborea.
G. asiatica.
Vitex negundo.
V. altissima.
Avicinnia officinnalis.

LAURACEAE.
Cryptocarya Wightiana.
Beilschmeidia fagifolia.
var. *Dalzellii.*
Cinnamomum zeylanicum.
C. macrocarpum.
Machilus macranthus—
Alseodaphne semicarpifolia.
Actinodaphne Hookerii.
Litsea tomentosa.
L. chinensis.
L. Stocksii.
L. Wightiana.
L. Zeylanica.

ELEAGNACEAE.
Eleagnus latifolia.

SANTALACEAE.
Santalum album.
Scleropyrum Wallichianum.

EUPHORBIACEAE.
Bischofia javanica.
Bridelia retusa.
Glochidion lanceolarium.

G. tomentosum.
G. zeylanicum.
G. Velutinum.
G. malabaricum.
G. Hehenackerii.
G. Johnsonii.
Fluggia microcarpa.
Phyllanthus Emblica.
P. indicus.
P. distichus.
Ptranjiva Roxbutrhii.
Hemicyclea venusta.
Cyclostemmon confertiflorus.
Antidesma Ghaesembilla.
A. Bunias.
Antidesma Menasu.
Buccauria coutalensis.
Jatropha glandulifera.
Croton reticulatus.
C. oblongifolius.
C. Gibsonianus.
Givotia rottlouformis.
Blachia dennudata.
Dimorphocalyx Lawiana.
Agrostistachys indica.
A. longifolia.
Adenochloa indica.
Trewia nudiflora.
T. polycarpa.
Malotus albus.
M. Phillipensis.
Glecidion javanicum.
Macaranga tomentosa.

Sapium insignae.
Execaecaria Agalocha.
E. robusta.

URTICACEAE.

Holoptelia integrifolia.
Celtis Cinnamomea.
C. Wightii.
Trema orientalis.
Geromiera reticulata.
Bohemeria malabarica.
Debregiasia velutina.
Streblus asper.
Plecosperrum spinosum.
Ficus gibbosus.
F. baghalensis.
F. mysorensis.
F. infectoria.
F. tomentosa.
F. callosa.
F. retusa.
F. glomerata.
F. Talbotii.
F. nervosa.
F. Rhumphii.
F. religiosa.
F. Arnoltiana.
F. Tsjakela.
F. Tseila.
Antiaris toxicaria.
Artocarpus hirsuta.
A. Lakoocha.
A. incisa.

SALICACEAE.

Salix tetrasperma.

S. ichnostachya.

Populus euphatica.

PALMACEAE.

Phoenix sylvestre.

P. robusta.

Caryota urens.

Corypha umbraculifera.

PANDANACEAE.

Pandanus furcatus.

GRAMINACEAE.

Oxytenanthera monostigma.

O. Stocksii.

Bambusa arundinaceae.

Dendrocalamus strictus.

CHAPTER X

NATURAL ORDERS HAVING CLIMBING PLANTS

1. Ranunculaceae.—Most.
2. Menispermaceae.—Most.
3. Capparidaceae.—Some.
4. Vitaceae. (Ampilidaceae.)—Most.
5. Sapindaceae.—Many.
6. Leguminosae.—Many.
7. Rosaceae.—Some.
8. Combretaceae.—Many.
9. Passifloraceae.—Most.
10. Cucurbitaceae.—Most.
11. Oleaceae.—Most.
12. Apocynaceae.—Many.
13. Asclepiadaceae.—Many.
14. Convolvulaceae.—Most.
15. Solanaceae.—Some.
16. Scrophulariaceae.—Some.
17. Bignoniaceae.—Some.
18. Acanthaceae.—Some.

19. Verbeaceae.—Some.
20. Nyctaginaceae.—Some.
21. Chenopodiaceae.—A few.
22. Polygonaceae.—Some.
23. Euphorbiaceae.—Some.
24. Bromeliaceae.—Many.
25. Aristolochiaceae.—Most.
26. Piperaceae.—Most.
27. Urticaceae.—Many.
28. Orchidaceae.—Many.
29. Dioscoriaceae.—Most.
30. Liliaceae.—Many.
31. Commelinaceae.—Some.
32. Aroidaceae.—Many.
33. Palmaceae.—Some.
34. Pandanaceae.—Some.
35. Anonaceae.—Some.

CHAPTER XI

PARASITIC NATURAL ORDERS AND GENERA STEM PARASITES

CONVULCULACEAE.	Cuscuta. Cosmopolitan.
LAURACEAE.	Cassytha.
LORANTHACEAE.	Loranthus. Viscum. Cosmo- politan.
ASCLEPIADACEAE.	Hoya retusa, and Hoya Wightii.

ROOT PARASITES

SCROPHCLARIACEAE.	Striga, Soperbia, Rhamphicarpa.
(all three on grasses)	Pedicularis (on other plants.)

OROBANCHACEAE.

Orobanche', Cistanche',
Ægenetia, Christisonia.

SANTALACEAE.

Santalum album.

BALANOPHORACEAE.

Balanophora indica on the roots
of Carissa carandas.

OLACACEAE.

Ximenia americana,
Olex scandens.
Cansjera Rheidi.

HOSTS OF LORANTHUS LONGIFLORUS

Current Science, Vol. IV,
Sept. 1935, pp. 160.

1. Psidium Guyava. My:
2. Melia azadirachta.
3. Cordia myxa.
4. Anona squamosa.
5. Punica granatum.
6. Tamarindus indica.
7. Citrus aurantium.
8. Millingtonia hortensis.

Current Science—IV,
June 1936, pp. 876.

1. Ægle marmelos.
2. Ficus infectoria.
3. Swetinia macrophylla.
4. Cassia fistula.
5. Thevetia nerifolia.
6. Sesbania aegyptica, var.
bicolour.
7. Morus indica.
8. Codium variegatum.

9. Gravillea robusta.
10. Cordia myxa.
11. Terminalia cattapa.
12. Cedrela toona.
13. Rosa sp.
14. Bauhinia variegata.
15. Premna mucronata.
16. Wrightia tomentosa.
17. Mangifera indica.
18. Melia Azadirach.
19. Psidium Guyava.
20. Ficus religiosa.
21. Dalbergia sissoo.
22. Albizzia Lebbeck.
23. Callistemmon linearis.
24. Casuarina equisetifolia.
25. Acasia auriculiformis.
26. Tectona grandis.
27. Bombax malabaricum.
28. Punica granatum.
29. Pongamia glabra.

Current Science Vol. V,
August 1936.

1. *Psidium* Guyava.
2. *Azadiracta indica*.
3. *Cordia myxa*.
4. *Anona squamosa*.
5. *Punica granatum*.
6. *Tamarindus indicus*.
7. *Citrus aurantium*.
8. *Millingtonia hortensis*.

9. *Morus indica*.
10. *Dalbergia sissoo*.
11. *Achras sapota*.
12. *Sapindus trifoliatus*.
13. *Acasia concinna*.
14. *Calotropis gigantia*.
15. *Murraya Connigii*.
16. *Eugenis Jambos*.
17. *Eriodendron anafractosum*.

CHAPTER XII

THE ESTUARIAL FLORA OF THE GODAVERY

Rhizophoraceae.

Rhizophora mucronata.
Ceriops Roxburghiana.
Bruguira conjugata.
Bruguira cyllindrica.

Verbenaceae.

Aveccinia officinalis.
Aveccinia alba.
Aveccinia maritima.
Clerodendron enerve'.

Lythraceae.

Sonneratia apetala.
Sonneratia acida.

Meliaceae.

Xylocarpus obovatus.

Combretaceae.

Lumnitzera racemosa.

Myrcenae.

Ægecerus corniculatus.

Euphorbiaceae.

Execaria agalocha.

Acanthaceae.

Acanthus ilicifolius.

Leguminosae.

Dalbergia spinosa.

Derris uliginosa.

Caesalpinia nuga.

Asclepiadaceae.

Sarcolobus carinatus.

Boraginaceae.

Heliotropium curassaricum.

Ficoidae. (Aizoaceae).

Sesuvium portulacastrum.

Chenopodiaceae.

Arthrocnemum indicum.

Salicornia bracheata.

Sueda maritima.

Sueda nudiflora.

Graminae.

Myriostachya Wightiana.

CHAPTER XIII

DESERT FLORA.

1. **Capparidaceae.**

Capparis aphylla.

2. **Zygophyllaceae.**

Tribulus terretris.

Tribulus alatus.

3. **Leguminosae.**

Alhagi camelorum.

Acasia arbica and other species of
Acasia.

4. **Vitaceae.**

Vitis quadrangulris.

5. **Ficoidae.**

Mollugo hirta.

Trianthema monogyna.

Trianthema crystallina.

Trianthema pentandra.

6. **Compositae.**

Echinops echinatus.

Launea lactucoides (in Aden).

Launea pentandra.

7. **Salvadoraceae.**

Salvadora persica.

Salvadora oleoides.

- | | |
|---------------------|---|
| 8. Asclepiadaceae. | Sarcostemma brevistigma.
Carraluma fimbriata.
Callotropis gigantea.
Callotropis procera. |
| 9. Boraginaceae. | Heliotropium zeylanicum
and other species. |
| 10. Convolvulaceae. | Ipomea biloba.
Evolvulus alsinoides. |
| 11. Nyctaginaceae. | Boerhaavia diffusa and other species.
Ærua javanica.
Ærua lanata. |
| 12. Chenopodiaceae. | Sueda monoica. (Salt lands).
Sueda fruticosa. |

CHAPTER XIV

HELOPHYTES

- | | |
|-------------------|---|
| Typhaceae. | Typha angustata. |
| Elatinaceae. | Bergia ammanoides.
Bergia capensis.
Bergia adorata. |
| Scrophulariaceae. | Limnophilla Roxburghii.
" conferta.
" gratissima.
" polystachya.
" sessiliformis.
" racemosa.
" gratioloides.
Moneira cuinifolia.
Stemodia viscosa.
Bonnaya veronicifolia. |

Polygonaceae.
Lythraceae.

Papilionaceae.
Acanthaceae.
Onagraceae.
Hydroleaceae.
Sterculiaceae.
Tiliaceae.
Compositae.

Companalaceae.
Tamaricaceae.
Amarantaceae.

Eriocaulaceae.
Graminaceae.

Illysanthes hyssopioides.
Illysanthes parviflora.
Peplidium humifusum.
Glossostigma spathulatum.
Polygonum serratum.
Ammania baccifera.
„ silicifera.
„ tenuis.
„ auriculata.
„ multiflora.
Aeschynomene indica.
Astercanthus longifolia.
Ludwigia parviflora.
Hydrolea zeylanica.
Melochia corcorifolia.
Corcorus sp.
Caesulia axillaris.
Blumea eriantha.
Eclipta erecta.
Sphenoclea zeylanica.
Tamarix gallica and dioica.
Amarantus spinosus.
Alternanthera triandra.
Eriocaulon trilobum.
Andropogon squarrosus.
Oryza sativa. (Wild Rice).
Coix lacyna—Jobbi.
Eriochloa polystachya.
Diplachne fusca.
Eragrostis gangeticus.
Ischemum rugosum.
Isleima Wightii.

Panicum colonum.
 „ psilopodium.
 „ punctatum.

Convolvulaceae:—Merremia emarginata.

Umbelliferae-Hydrocotyle asiatica.

Verbenaceae-Lippia nudiflora.

Acanthaceae-Lepidaghatia cristata.

CHAPTER XV

GIANT CLIMBERS

Anamirta paniculata.	(Cocculus indicus.)	Menispermaceae.
Anodendron paniculatum.		Apocynaceae.
Bauhinia anguina.	(Snake	Leguminosae.
climber).		
Bauhinia Vahlia.		Leguminosae.
Caesalpinia nuga.		Leguminosae.
Calamus rotung.		Palmae.
Celastrus paniculatus.		Celastraceae.
Cocculus macrocarpus.		Menispermaceae.
Derris scandens.		Leguminosae.
Distictis lactiflora.		Bignoniaceae.
Entada polystachya.		Leguminosae.
E. scandens.		„
Salacia reticulata.		Celastraceae.
Securidaca volubilis.		Polygalaceae.
Toddalia aculeata.		Rutaceae.
Willughbeia zeylanica.		Apocynaceae.

SAND BINDING PLANTS

Barringtonia racemosa.	Myrtaceae.
Calotropis gigantea.	Asclepiadaceae.

Canavalia obtusifolia.
Cassia auriculata.
Ipomea biloba.
Pandanus odoratissimus.
Scaevola Koenigii.
Spinifex squarrosus.
Tamarix gallica.

Leguminosae.
 Leguminosae.
 Convulvulaceae.
 Pandanaceae.
 Goodeniaceae.
 Graminae.
 Tamaricaceae.

TREES SUITED FOR SWAMPY SITUATIONS

Low country.

Anacardium occidentale.
Anona palustris.
Barringtonia speciosa.
Carludovia palmata.
Casuarina equisetifolia.
Cerebera odollum.
Colocasia antiquorum.
Cyperus papyrus.
Eucalyptus robusta.
Panicum muticum — (Para
 Grass).
Heritiera littoralis.
Hermineira elaphroxylon.
Legerstroemia flos-regina.
Metroxylon Sagu.
Nipa fruticans.
Ochrosia borbonica.
Saccharum arundinaceum.

The Elephant Grass.
Saccharum offinarum.
 Sugar cane.
Scaevola Koenigii.
 For up-country.
Acasia dealbata.
Eschynomene indica.
Eucalyptus globulus.
 „ *leucoxylon.*
 „ *robusta.* (Iron bark)
 and other species of
Eucalyptus trees.
Fatsia papyrifera.
 Many Fodder Grasses.
Gunnera maniculata.
Hedichium coronarium.
 „ *gardnerianum.*
Phormium tenax.
Salix babylonica.
Terminalia glabra.

TREES SUITED FOR ARID REGIONS

Acasia Farnesiana.
Albizzia Lebbeck.

Butea frondosa.
Casuarina equisetifolia.

Dalbergia sissoo.	Plumeria rubra.
Dodonea viscosa. For fencing.	Poinciana regia.
Eucalytus citriodora.	Populus albus.
Ficus Benjamina.	Prosopis juliflora.
Jacaranda mimosaeifolia.	Salix babilonica.
Ceratonia (Locust Bean).	Salvadora persica.
Melia Azedarach.	Tamarindus indicus.
Morus indica.	Tamarix articulata.
Parkinsonia aculeata.	„ gallica.
Phoenix dactilifer.	Zizyphus Spina Christi.

SHRUBS SUITED FOR ARID REGIONS

Buddelia paniculata.	Punica granatum.
Ricinus communis.	Russelia juncea.
Clerodendron odoratum.	Schinus molle.
—For hedges.	Sesbania egyptiaca.
Euphorbia pulcherima.	Tamarix mannifera.
Hibiscus syriacus.	Tecoma stans.
Lawsonia alba.—For hedges.	Thevetia neriefolia.
Nerium oleander.	

PLANTS SUITED FOR HEDGES

Bougainvilleas of various colours.	Nyctaginaceae.
Dodonea viscosa.	Sapindaceae.
Lawsonia alba.	Lythraceae.
Nerium oleander.	Apocynaceae.
Pithecolobium dulce.	Leguminosae.
Zizyphus Spina-Christi.	Rhamnaceae.

CLIMBERS SUITABLE FOR SCREENS

Antigonon leptopus.	Polygonaceae.
Bignonea venusta.	Binonnaceae.

Bougainvillea sp.
Ipomea palmata.
(The Railway creeper).
Jasminum azoricum.

Nyctaginacea.
Convolvulaceae.

Oleaceae.

COMMON FLOWERS GROWN IN GARDENS

Antirrhinum.
Asters.
Callandula persica.
Candytuft.
Chrysanthemums.
Coreopsis.
Dianthus.
Eschscholletia.
Gaillardias.
Gladiolus.

Grape Hyacinth.
Hollyhock.
Larkspur.
Linum.
Narcissus.
Petunia.
Poppy.
Rose (Persian).
Verbena.

CHAPTER XVI

PLANTS OF NORTHERN GUJERAT

Class i. Hydrophytes

Abundant:—Nymphaea Lotus, Ipomea aquatica. Hydrilla verticillata, Vallisneria spiralis, Zannichelia palustris, Potamogeton pectinatus. Azolla sp., Chara. 2 or 3 sp., Nitella, and various other Algae.

Common:—Nelumbium speciosum, Potamogeton perfoliatus, P. Crispus, Limnophyton obtusifolium, Trapa bispinosa. (Cultivated) Naias minor, Utricularia stellaris, Lemna polyrrhiza.

Local:—Limnanthemum sp. Jussia repens, Cerratophyllum demersum.

Class 2. Helophytes

Reed swamp formation:—*Typha angustata*, *Andropogon squarrosus*, *Cyperus levigata*, *Herpestris moneira*, *Lippis nodiflora*, and *Marsilia Quadrifida*, *Blepharis molluginifolia*, *Sporobolus tremulsus*, *tremulus*, *Cyperus pygmeus*, *Eliocharis plantaginae*.

Cyperaceae, *Cyperus alopicurus*, *C. Iria*, var. *paniciformis*, *C. eluesinoides*, *C. difformis*, *C. tegetum*.

Scirpus littoralis, *maritimus*, *Fimbristylis ferruginea*, and *dichotoma*, *complanata*, *quinquiangularis*, *Fuirena glomerata*, *Cyperus globosa*.

Graminae:—*Oryza sativa*, *Coix lacryma Jobbi*, *Eriochloa polystachya*, *Diplachna fusca*, *Eragrostis gangetica*, *Ischemum rugosum*, *Isclima Wightii*, *Panicum colonum*, *P. psilopodium*.

Other Spermaphyta:—*Monochoria hastifolia*, *Polygonum serrulatum*, *Glossostigma spathulatum*, *Eriocaulon trilobum*, *Ammania baccifera*, *A. salicifolia*, *A. tenuis*, and *auriculata*, and *multiflora*. *Aeschynomene indica*, *Hygrophila polysperma*, *Ludwigia parviflora*, *Asteracanthus longifolia*. *Hydrolea zeylanica*. *Melochia corcorifolia*, *Sesbania aculeata*. *Corcorus* sp., *Cæsulia axillaris*, *Blumea eriantha*, *Sphenochlea zeylanica*, *Tamarix dioica*, *Alternanthera triandra*.

II Dried Mud Formation

Polygonum plebigium, *Coldenia procumbens*, *Mollugo hirta*, *Grangea madaraspatana*, *Sphaeranthus indicus*, *Eclipta erecta*, *Chrozophora prostata*, *Euphorbia microphylla*, *Gnaphalium indicum*, and *pulvinatum*, *Heliotropium supinum*, *Trigonella oculata*.

Halophytes

I. Association of Halophytic Savannah at Kharagoda.

Indigofera paucifolia, *Acacia arabica*, *Sueda nudiflora*.
Corchorus antichorus, *Launea pinnatifida*, *Physalis minima*,
Blumea amplexicaule, *Aleuropus villosus*, *Tamarix gallica*.

II. Halophytic Semi-Desert at Prantej.

Sporobolus orientalis, *Chloris villosa*, *Eleusineegyptiaca*,
Diplachne fusca, *Fimbristylis spathacea*.

Lithophytes

(a) Very common, and always present.

Lindenbergia urticifolia, *Linaria ramosissima*, *Eragrostis tennela*,
Arthraxon microphylla, *Aristida adsenscionis*, *Andropogon contortus*.

(b) Occasional:—*Acalypha indica*, *Alternanthera triandra*,
Launea pinnatifida.

Psammophytes & Psilophytes

I. Xerophytic Woodland.

Terminalia tomentosa.

Boswellia serrata.

Phyllanthus emblica.

Aegle marmelos.

Tectona grandis.

II. Woodland Savannah.

Trees

Tectona grandis, *Mitragyna parviflora*, *Aegle marmelos*,
Morinda cirifolia, *Sterculia urens*, *Diosypros melanoxylon*,
Odina Woodier, *Anoguissus pendula*, and *sericea*.

Shrubs and undershrubs.

Helicteris isora, *Carrisa carandas*, *Holarrhina antidysentrica*, *Alangium Lammarkii*, *Wrightia tinctoria*, *Nyctanthes Arbor-tristis*, *Flacourtia sepiaria*, *Grewia hirsuta* and *pilosa*. Herbs:—*Nevracunthus sphaerostachys*. *Tubiflora acaulis*, *Desmodium gangeticum*.

III. Thorn Savannah.

Woody members:—*Zizyphus jujuba*, *rotundifolia* and *Z. Oenoplia*, *Gymnaosporia montana*, *Cassia auriculata*, *Capparis aphylla*, *C. sepiaria*, *Balanites Roxburghi*, *Acasia Senegal*, and *leucophlea*, *A. Jacquemontia*, *Mimosa Hamata*, *Plectronia parviflora*, *Bauhinia racemosa*, *Grewia populifolia* and *G. villosa*.

Common lianes:—*Asparagus racemosus*, *Leptadenia reticulata*, *Cocculus villosus*.

The under-vegetation:—*Lepidaghatia trinervis*, *Convolvulus pluricaulis*, *Evolvulus alsinoides*.

IV. Butea Savannah.

Butea frondosa, *Cassia auriculata*, *Triumfetta rotundifolia*, *Ophiurus corymbosus*, *Bassia latifolia* and *Bombax malabaricum*.

V. Butea-Dichrostachys Thorn Savannah of the Laterite Plateau, Talod.

(i) **Trees:**—*Butea frondosa*, *Acasia arabica*, and *Acasia leucophlea*.

(ii) **Shrubs:**—*Dichrostachys cinera*, *Mimosa hamata*, *Grewia villosa*, *Capparis aphylla*, *Zizyphus rotundifolia* and *Neptunia triquetra* is rare.

(iii) **Climbers:**—*Cocculus villosus*, *Pentatropis microphylla*, *Rhynchosia minima*, *Marsdenia volubilis*, *Ipomea dissecta*, *I. calycina*, *I. obscura* and *I. hederaceae*.

(iv) Herbs:—

(a) Of the herbaceous plants, the grasses predominate:—
Digitaria pedicularis, *D. Royleana*, *D. longiflora*, *Manisuris granularis*, *Andropogon contortus*, *Iseilema laxum*, *Aristida funiculata*, *Eragrostis bifaria*, *E. pilosa*. (Small form).

(b) Among the grasses are a considerable variety of herbaceous Dicotyledons, none of which are in any sense dominant. *Lepidaghatia trinervis*, *Blepharis molluginifolia*, *Glossocardia linearifolia*, (These three especially abundant.) *Phyllanthus madaraspatensis*, *Crotalaria linifolia*, *Hibiscus esculentus*, *H. punctatus*, *Polygala eriopetra*, *Leucas stricta*, *Volutarella divaricata*, *Alysicarpus buplurifolius*, *Ionidium heterophyllum*, *Sesamum indicum*, *Hibiscus micranthus*, *Crotalaria orixensis*, *Indigofera trita*, *Cleome simplicifolia*, *Indigofera glandulosa*, *Polygala chinensis*, Finally *Striga euphrasoides* is a common root parasite on many of the grasses.

Swampy hollows contain *Characeae* and *Oryza sativa*, and some *Cyperaceae*. They also contain the following **Marsh loving plants**. *Sesbania aculeata*, *Aeschynomene indica*, *Melochia corcorifolia*, *Hoppea dichotoma*, *Fimbristylis dichotoma*, *F. ferruginea*, *F. complanata*, *F. schoenoides*, *Eleocharis atropurpurea*, *Eriocaulon trilobum*, (The last two are much alike). *Butomopsis lanceolatus*, *Limnophylla gratioloides*, *Ammania mutiflora*, *Hydrolea zeylanica*, *Andropogon squarrosus*, *Scleria* sp., *Oryza sativa*.

Note:—After several months of draught *Capparis aphylla* and *Zizyphus rotundifolia* were noted as conspicuous, but from August to October these seem to occupy a more subordinate position.

VI. Association of Savannah with tall grasses.

The tall grasses associated with grasslands are a conspicuous feature of North Gujarat.

The principal herbaceous members of this association are as follows:—*Ischemum rugosum*, *Andropogon Schenanthus*, *A. foveolatus*, *A. annulatus*, *A. contortus*, *Apluda varia*, *Iseilema Wightii*, *Anthistiria ciliata*.

These grasslands are nowhere treeless. Besides the trees mentioned under xerophytic Woodlands and Bute asavannah, we have noted *Capparis grandis*, *Moringa pterigosperma*, *Dolicandron falcata*, and others. In fact any tree or shrub found in our area may occur.

VII. Other types of savannah on sandy soil.

(i) **Trees.** *Mangifera indica*, *Ailanthus exelsa*, *Azadiracta indica*, *Mimusops hexandra*, *Bassia laitfolia*, *Cordia myxa*, *Acacia arabica*.

(ii) Shrubs and under-shrubs.

(a) More or less abundant:—*Cassia auriculata*, *Calotropis procera*, *Abutilon indicum*, *Zizyphus rotundifolia*.

(b) More or less common:—*Balanites Roxburghii*, *Pavonia zeylanica*, *Acacia Jaquemontii*, *Gymnopsoria montana*, *Capparis aphylla*.

Waltheria indica, *Ocimum cannum*, *Crotalaria Burhia*, *Cassia obtusa*, *Grewia pilosa*, *Tephrosia purpuria*, *T. villosa*, *Crotalaria medicaginea*, var *neglecta*. The last three and sometimes also *Cassia auriculata*, are liable to form dense colonies, dominating the entire vegetation.

(c) Fairly common but never becoming dominant.

Trichodesma indicum, *Triumfetta rhomboidea*, *T. rotundifolia*, *Leptadenia Spartium*.

(iii) **Climbers.** (a) Abundant :—*Leptadenia reticulata*, *Cocculus villosus*.

(b) Common:—*Asparagus racemosus*, *Pentatropis microphylla*, *Gloriosa superba*.

(iv) Herbs. (Not persisting through the dry weather but more or less fugaceous).

(a) Abundant:—*Indigofera linifolia*, *cordifolia* *enneaphylla*, *Alysicarpus vaginalis*, *Cassia Tora*, *Oldenlandia corymbosa*, *Justicia diffusa*, var. *orbiculata*, *Leucas cephalotus*, *Commelina nudiflora*, *Cenchrus catharticus*, *Perotis latifolia*, *Eragrostis tremula*, *Eleusineegyptiaca*.

(b) Common:—*Cleome viscosa*, *Polygala erioptera*, *Ionidium heterophyllum*, *Sida cordifolia*, and *veronicifolia*, *Heylandia latebrosa*, *Zornia diphylla*, *Crotalaria linifolia*, *Alysicarpus hamosus*, *Spermacoce stricta*, *Enicostema littorale*, *Striga euphrasoides*, *Leucas urticifolia*, *Phyllanthus neruri*, *Euphorbia pilulifera*, *Cyperus niveus*, *C. arenarius*, *C. conglomeratus* and *Iria*, *C. aristata*. *Kyllinga triceps*, *Stenophyllum barbata*, *Setaria glauca*, *Panicum ramosum*, *P. disticum*, *P. trypheron*, *Digitaria sanguinalis*, var. *ciliaris*, *Sachharum spontaneum*, *S. Munja*, *Andropogon foveolatus*, *A. contortus*, *Aristida redacta*, *Tragus racemosus*, *Sporobolus diander*, *Eragrostis tennela*, var. *plumosa*, *E. pilosa*, *E. cynosuroides*. *Gracilea Royleana*, *Cynodon dactylon*, *Chloris villosa*, *C. barbata*, *C. incompleta*, *Eleusine verticillata*, *E. aristata*.

(c) Occasional:—*Hibiscus esculentus*, *Corchorus olitorius*, *C. acutangularis*, *Crotalaria mysorensis*, *C. pusilla*, *C. retusa*, *Indigofera hirsuta*, *Tephrosia tennuis*, *Alysicarpus monilifer*, *Giseikia pharnaceoides*, *Blainvillea rhomboidea*, *Martenia diandra*, *Ruellia patula*, var. *alba*, *Blepharis molluginifolia*, *Salvia egyptiaca*, var. *pumila*, *Phyllanthus madaraspatisensis*, *Euphorbia hypericifolia*, var. *parviflora*, *Sopubia delphinifolia*.

(v) Herbs (or plants mainly herbaceous) which continue their reproductive functions through at least a considerable period of dry weather:—

Abundant:—*Lepidagathis trinervis*, *Convolvulus pluricaulis*, *Evolvulus alsinoides*, *Boerhaavia diffusa*. *Vernonia cinera*, *Tribulus terrestris*.

(b) **Common:**—*Voluterella divaricata*, *Bergia odotata*, *Launea nudicaulis*.

This type of Savannah covers wide areas and remains but little altered from Ahmedabad westward to Kharagoda.

VIII. Psammophytes.

(1) **Dunes.** These are dominated either by *Saccharum Munja* or by *Crotalaria Burhii* and associated with these are *Cyperus niveus*, *C. arenarius*, *C. conglomeratus*, and many members of the Sand Savannah.

(2) **The River bed.** The usual association is *Acasia Jaquemontii*, *Leptadenia Spartium* and *Cassi auriculata*.

Mesophytes

Mesophytic Bushlan.

(i) **Trees:** *Azadiracta indica*, *Cordia Rothii* and others.

(ii) **Shrubs:** *Grewia populifolia*, *Gymnosporia montana*, *Clerodendron Phlomoides*, *Abutilon indicam*, *Trichodesma indicum*, *Zizyphus Jujuba*.

(iii) **Climbers:** *Daemia extensa*, *Ipomea calycina*, *I. pilosa*. *I. dasysperma*, *Merrimia pentaphylla*, various *Cucurbitaceae*, *Cocculus villosus*, *Pupalia lappaca*, *Achyranthes aspera*, *Pentatropis microphylla*.

(iv) **Herbs.** *Corchorus olitorious*, *Abutilon ramosus*, *Commelina nudiflora* and others.

The second Mesophytic association is found on small patches of ground kept constantly moist by springs.

Cythocline lyrata, *Emilia sonchifolia*, *Blumea eriantha*, *Hygrophylla Serpyllum*, *Hemigraphis elegans*, *Leucas biflora*, *Canscora decurrens*, *Exacum pedunculatum*, *Gnaphalium indicum*.

Weeds of Cultivation

Monsoon Aspect.

(i) Abundant:—*Spermacoce hispida*, *Vernonia cinera*, *Justicia diffusa*, v ar. *orbicularia*, *Leucas Cephalotus*, *Digera arvensis*, *Celosia argentia*, *Commelina nudiflora*, *Cyperus rotundus*, *Stenophylla barbata*, *Eragrostis tennela*, var. *plumosa*, *Cenchrus catharticus*.

(ii) Very Common:—*Gynandropsis pentaphylla*, *Polycarpoea corymbosa*, *Portulaca quadrifida*, *Alysicarpus longifolius*, *Vicoa auriculata*, *Lochnera pusilla*, *Heliotropium zeylanicum*, *Phyllanthus Niruri*, *Eragrostis minor*.

(iii) Common:—*Bergia odorata*, *Tribulus terrestris*, *Trianthema monogyna*, *Dicoma tomentosa*, *Sopubia delphinifolia*, *Euphorbia pilulifera*, *E. prostrata*.

Cold Weather Aspect

(i) Abundant:—*Chenopodium album*, *Asphodelus tenuifolius*, *Gynandropsis pentaphylla*,

(ii) Very Common:—*Melilotus indica*, *Datura fastuosa*, var. *alba*, and *D. fastuosa*.

(iii) Common:—*Argemone mexicana*, *Oxalis corniculata*, *Anagallis arvensis*, *Foeniculum vulgare*.

(iv) *Saponaria Vaccaria*, *Amarantus polygamus*, *Convolvulus arvensis*.

Hedge Plants

(i) Small trees, shrubs and undershrubs, such as form the upper storey of self-supporting plants, and the scandant shrubs.

(a) Very Common. *Euphorbia nerifolia*, *Zizyphus oenoplia*, *Capparis sapieria*, *Clerodendron Phlomoides*, *Phyllanthus reticulatus*.

(b) Common but not invariably present:—

Salvadora oleoides, *S. persica*, *Capparis aphylla*, *Abutilon indicum*, *Pavonia zeylanica*, *Zizyphus rotundifolia*, *Plumbago zeylanica*.

(c) Fairly Common. *Maera ovalifolia*, *Cadaba indica*, *Streblus asper*, *Zizyphus Jujuba*.

(d) Occasional, or sometimes locally common:—

Lawsonia enermis, *Dodonea viscosa*, *Euphorbia tirucalli*, *Diospyros coedifolia*, *Fluggea leucopyrus*, *Anona squamosa*, *Caesalpinia bonducella*, *Plectronia parviflora*, *Lantana camara*, *Euphorbia ligularia*, (Planted).

(e) Rare—*Lycium barbatum*, *Acasia Intsia*, *Flacourtia sepieria*, *F. Ramontchi*, *Capparis grandis*.

(ii) Climbing Plants.

A. Herbaceous annuals, generally seen only during and immediately after the rains. All, with one exception are *Cucurbitaceae*:—

(a) Abundant—*Trichosanthes cucumerina*, *Coccinia indica*.

(b) Common—*Melothria madaraspatena*, *Momordica dioica*, *Cardiospermum halicacabum*.

(c) Fairly common.—*Kedrostis rostrata*, *Blastania Garcini*.

(d) Occasional, or locally common.

Luffa acutangula, *Momordica Balsamina*.

(B) Perrianial from an underground tuber, but aerial parts as above—*Gloriosa superba*. (Fairly common).

(C) More or less woody, and in most cases perennial.

Persistent long after the rains have ceased:—

(a) Abundant—*Cocculus villosus*, *Pupalia lappacea*, *Achyranthes aspera*.

(b) Very Common—*Clitorea ternatea*, *Leptadenia reticulata*, *Abrus precatorious*, *Rivea hypocrateriformis*, *Cannavallia ensiformis*, *Daemia extensa*.

(c) Common—*Boerhaavia verticillata*, *Tellosma pallida*, *Rhyncia minima*, *Ipomea obscura*, *Teramnus labialis*, *Ipomea pes-tigridis*.

(d) Occasional, or Local.—*Ipomea sepieria*, *Vitis trifoliata*, *Calonyction muricatum*, *Cuscuta reflexa*.

(e) Rare—*Merrimia dissecta*, *Mucuna pruriens*, *Cuscuta chinensis*, *Cissampelos Pereira*, *Boerhaavia repanda*.

(iii) HERBS.—Many herbs may be found in the shade of the hedges, but the following are specially characteristic of such situations—*Tridax procumbens*, *Ruelia patula*, *Peristrophe bicaliculata*, *Ionidium heterophyllum*, *Sclerocarpus africanus*, *Anisomelis ovata*, *Panicum antidotale*, *Apluda varia*.

CHAPTER XVII

ECOLOGY OF THE CHATTERSHINGHEE FOREST.

Among the xerophytes the following deserve special mention:—

Compositae.

Tridax procumbens.

Vernonia cinera.

Nyctaginaceae.	Launea nudicaulis.
	Echinops echinatus.
	Boerhaavia diffusa.
	B. repens.
Zygophyllaceae.	Tribulus terrestris.
Convolvulaceae.	Evolvulus alsinoides.
Euphorbiaceae.	Euphorbia pilulifera.
	E. thymifolia.
Leguminosae.	Indigofera linifolia.
Polygalaceae.	Polygala erioptera.
	P. chinensis.

Calcicaulous Plants.

Euphorbia pilulifera.	Indigofera linifolia.
	Polygala chinensis.
E. thymifolia.	P. erioptera.
Phyllanthus madaraspatensis.	Argemone mexicana.
Vernonia cinera.	Linaria ramosissima.
Launea nudicaulis.	Tribulus terrestris.
Echinops echinatus.	Evolvulus alsinoides.
	Justicia diffusa.

Root Parasites.

Scrophulariaceae.	Striga lutea.
	S. densiflora.
	S. orobanchoides.
	Sopubia delphinifolia.

The following assume the espalier shape:—

Indigofera cordifolia.	Heylandia latebrosa.
I. linifolia.	Phyllanthus madaraspatensis.

Petrophytes.

<i>Rhus mysorensis.</i>	<i>Linaria ramosissima.</i>
<i>Woodfordia floribunda.</i>	<i>Mimosa hamata.</i>
<i>Acasia leucophlea.</i>	<i>Sarcostemma brevistigma.</i>

Chylophyllous Plants.

<i>Scilla indica.</i>	<i>Cyanotis tuberosa.</i>
<i>Chlorophytum tuberosum.</i>	<i>Indigofera linifolia.</i>
<i>Chailochara</i> :— <i>Carraluma fimbriata.</i>	
<i>Sarcostemma brevistigma.</i>	

Scephyllous Plants.

<i>Scilla indica.</i>	<i>Curculigo orchioides.</i>
<i>Asparagus racemosus.</i>	<i>Corralocarpus epigeus.</i>
<i>Ceropigia hirsuta.</i>	<i>Vitis Woodrowii.</i>

Lianas.

Vitaceae.	<i>Vitis Woodrowii.</i>
	<i>Vitis setosa.</i>
Leguminosae.	<i>Abrus precatorius.</i>
	<i>Phaseolus trilobus.</i>
	<i>Rhynchosia minima.</i>
Cucurbitaceae.	<i>Corralocarpus epigea.</i>
Asclepiadaceae.	<i>Ceropigia hirsuta.</i>
	<i>Dregea volubilis.</i>
	<i>Hemidesmus indicus.</i>
	<i>Leptadenia reticulata.</i>
	<i>Sarcostemma brevistigma.</i>
Convolvulaceae.	<i>Rivea hypocrateriformis.</i>

CHAPTER XVIII

CLASSIFICATION OF FOREST TYPES.

Definition: The better defined and more stable of the developmental stages in the history of our forests are usually to be assigned as **forest types**, though no adequate definition can be given, particularly for the non-climax types; the degree of subdivision to which we must go for practical purposes in differentiating types depends largely on the intensity of management. Thus at present we continue to deal with our wet tropical evergreen as a single type despite its obvious complexity and variation, whilst for forest with Sal as the predominating species, it has been found advisable to distinguish at least 13 and preferably 21 sub-types differing to such an extent that a treatment applied in one might produce different results in another. For practical forestry purposes, a simple classification and standard nomenclature are required to cover the great variety of forests found in the country ranging from the dense moist evergreen occurring on the west coast, in Upper Assam and other parts, to the open thorny shrub, hardly worthy of the name of forest on the edges of the deserts; to scrub again on the mountain tops at timber-limit; to dense low evergreen in the tidal estuaries; and to open park or grassland in both hills and plains.

Forest Types in Relation to Climate

Factors of climate affecting forest types:—

The close relationship between climate and the form of climax forest is so marked that most students of climate find

the vegetation itself the best indication and measure of the summation of the climatic factors. The chief of these factors are temperature and moisture, the others such as wind being relatively much less influential.

Temperature: Given adequate moisture, the effect of temperature shows itself in the luxuriance of the forest in that the height, density, variety of species and rate of growth all fall off with falling temperature. The Conifers react somewhat differently from the broad-leaved trees, reaching their best development in temperate climates, where they surpass their broad-leaved associates. Ascending in the hills with increasing cold, winter-deciduous species become more prevalent, and the forest gradually degenerates to scrub form at timber limit, where however hard-leaved evergreens predominate (*Rhododendron*).

Moisture: As moisture conditions become less favourable with tropical temperatures, the forest falls off in density and in richness in species, and an increasing proportion of species become summer-deciduous, first in the top storey, and then lower down also. In still drier climates, the height also falls off and the leafless period lengthens, thorny trees become more abundant, and xerophytic adaptations become more and more prevalent till an open thorn scrub stage is reached, the last that can be considered as forest.

Temperature Zones: Four temperature zones require to be recognized in India as follows:—

(1) **Tropical:**—Mean annual temperature over 75°F ; mean January temperature over 65°F . Cold season short or absent. Frost and snow unknown. This occupies the whole country within the tropics except for the higher hills.

(2) **Sub-Tropical:**—M.A.T. 62° to 75°F . mean January temperature 50° to 65°F . Cold season definite but not severe.

Frost rare. This occupies the northern part of the country below about 5,500 feet and the southern hills between 3,500 feet and 6,000 feet.

Temperate:—M.A.T. 45° — 62° F; mean January temperature 30° to 50° F. Winter pronounced with frost and some snow. Hills above 6,000 feet in the south and between 5,500 feet and 10,000 feet in the north.

Alpine:—M.A.T. below 45° F.; mean January temperature below 30° F. Winter long and severe.

There is one respect however in which this climate classification is not altogether suitable for application for forest types for many of the latter in the plains are almost identical in tropical and sub-tropical climatic zones, the effects of the hot dry early summer, followed by the wet monsoon period common to both, outweigh the differences due to the minor differences in the dry cold weather when in any case there is little vegetative activity.

Moisture effects: The relative prevalence of mesophytic or xerophytic evergreens and of deciduous or thorny species, indicate well the varying moisture conditions within the climatic zones, and lead to the classification given later, in which some of the better characterized edaphic and seral types are included in brackets, the remainder being viewed as climatic climaxes.

Forest Types in Relation to Soil.

Soil Factors: The undisturbed type of vegetation which clothes a given tract of country is thus found to reflect very clearly the prevailing climate; variations within the climate are clearly connected with soil differences and the soil itself may, as we have seen, also be ultimately determined to a large degree by climate. Thus a pronounced laterite soil is developed from

a variety of rocks under appropriate climatic conditions and often carries a similar type of vegetation. Physical differences in soil may, however cause considerable differences in the climate of the soil itself; thus a cold wet clay may closely adjoin a warm light sandy soil, and the vegetation on the two soils may present marked differences. The change from (predominantly) Sal forest to (predominantly) Teak forest in the Central Provinces is ascribable in this way to change of soil, not change of climate, and many similar examples are on record.

Predominant Effect of Physical Properties: As a rule, even when there are marked chemical differences in the parent rock, as between limestone, quartzite and granite, the difference in vegetation is less determined by the chemical than by the physical differences in the soil. Some trees appear remarkably indifferent to soil, as is well illustrated by Chir Pine, which is found on an extremely wide range of rocks; but here the hilly topography results in adequate drainage, which is the chief essential for that growth of this tree.

It should be noted that because a given species predominates on an inferior soil, it does not follow that this soil is the most favourable to it. More usually, the implication is greater hardiness or adaptability than that of its competitors which can crowd it out on better soils thus *Terminalia tomentosa* often predominates on stiff clay but grows infinitely better on a deep rich loam.

Soil Indicators: Bearing these considerations in mind, it can still be said that in India certain soils with pronounced characteristics are commonly associated with certain species or types. As examples may be cited the following:—

New River Gravel. Khair—Sissu association.

Black Cotton Soil—*Acacia arabica*.

Markedly Saline Soil—*Prosopis specigera*. *Tamarix articulata*, *Acacia arabica*.

Coastal Sand—*Callophyllum inophyllum*, *Casuarina equisetifolia*, *Hibiscus tiliaceus*.

The various forms of Tidal forests are also closely related to soil conditions, mainly moisture and salinity.

In Burma, it has been shown that as a rule the superficial horizons determines species (through their influence on regeneration) whilst variations in the profile limit height and growth. Dominant Teak is associated with finer soil of the older alluvium and overlying black soil deposits, and other soils like them.

Lime Content and Vegetation: Forest and Botanical literature are full of references to 'Calcifugous' and 'Calcicolous' species, respectively avoiding and preferring soils rich in lime, but it is now realized that the chief effect of lime in the soil is not as a plant nutrient or poison, but as modifier of soil conditions both physical and chemical. A species may differ markedly in its relation to lime soils in different parts of its climatic range, being for example calcicolous in colder northern and higher localities, and more or less calcifugous in warmer regions (Beech in Europe). This is related to the lower soil humidity and hence greater salt concentration in the warmer sites.

Forest Types in Relation to Biotic Factors

The far reaching of human activities in clearing forest, in burning, and in grazing flocks, are well-known.

Under natural conditions, it is unlikely that wild animals such as elephant, deer and pig, ever do enough damage to influence the dominant forest types, though their undue multiplication and local concentration through human interference

now renders them important in regeneration operations. Similar is the matter in insect attack, each species and type of forest being adapted to cope with the amount of injury to which it is exposed under natural conditions.

Savannah Type: In India the most easily distinguished form of forest owing its existence to boitic factors is grassy Savannah forest. The climate is such as to support tree vegetation wherever closed vegetation is possible, and not grassland, but extensive areas are met with in which the tree-cover has been kept or rendered very open, and grass has taken possession of the soil. Owing to its inflammability, and its being frequently fired in connection with grazing, the Savannah types perpetuate themselves and are, in fact very stable sub-climaxes. The boundary lines between adjoining forest types tend to be shifted in favour of the more xerophytic wherever human influences are at all pronounced.

Chief Forest Types and Their Characteristics

The following list is taken in abridged form from a recently compiled survey for India and Burma. Brackets imply edaphic climaxe or seral stages.

I. Moist Tropical Forests

1. **Tropical Wet Evergreen.**—Tall dense forest with mesophytic evergreen predominating in all canopy layers.

(i) **A Evergreen Dipterocarpus**—Evergreen Dipterocarpus conspicuous; the finest forest in India.

(Fresh Water Swamp). Less dense with fewer species.
(Tidal Forest). A complex of successional types all evergreen but rarely tall or dense.

(Secondary Dipterocarpus). *Hopes* spp. in almost pure crops of medium to poor quality.

(Wet mixed forest). An evergreen type succeeding Sal forest on wet ground.

(Cane brakes). Occupy wet hollows in the main type.

2. **Tropical Semi-evergreen.**—Deciduous species occur mixed with the evergreens in the top canopy, the lower canopy being mainly evergreen. Leafless period short.

(Gurjan Forest). *Dipterocarpus* spp. of rather poor quality predominates.

3. **Tropical Moist Deciduous.**—Deciduous species predominate in the top canopy with more or less evergreen in the lower canopy.

3a. Moist (mixed) deciduous. Several species, including Teak, contribute equally to the top canopy.

3b. Moist Sal. Sal largely predominates in the top canopy.

(Moist Savannah). Open deciduous forest with heavy grass soil cover.

(Bamboo Brakes). Usually due to destruction of the overwood.

II. Dry Tropical Forests

4. **Tropical Dry Deciduous.**—Low forest almost entirely deciduous in all canopies.

4a. Dry (mixed) deciduous.—Several species contributing equally to the top canopy, including teak.

4b. Dry Sal. Sal predominates in the top canopy.

(Khair Sissu). A nearly pure forest of these two species in varying proportions, occurring on new sandy or gravelly Indo-Gangetic alluvium.

(Tamarisk-Poplar). A nearly pure forest of these two species on new alluvial deposits along the Indus.
(Dry Savannah). Open deciduous forest over grass.
(Inding). Deciduous Dipterocarpus forest on sandy soil and hills in Burma.

5. **Tropical Thorn.**—A low open pronouncedly xerophytic forest in which thorny leguminous species predominate (*Acacia*, *Prosopis*).

6. **Tropical Evergreen.**—A low but often dense dry evergreen forest developed on the Carnatic coast with no summer rain. Small leaved and thorny species predominate.

(Beach Forest). A thin evergreen forest developed on coastal sands with *Casuarina* as the characteristic species.

III. (Montane) Subtropical Forests.

7. **Subtropical Wet Hill Forest.**—Tall luxurient forest with evergreen species predominating.

8. **Subtropical Pine.**—Open inflammable pine forests with or without an evergreen underwood.

9. **Subtropical Dry Evergreen.**—A xerophytic type including thorny species and small leaved evergreen such as olive.

(Subtropical Savannah). Trees scattered thinly or in groups on grassland.

IV. (Montane) Temperate Forests.

10. **Wet Temperate Forests.**—Evergreen or semi-evergreen mixed forests with dense undergrowth.

10a. **S. Wet Temperate.** Dense low evergreen forests of mixed species.

rob. N. Wet Temperate. Tall forests of mixed evergreen (*Castanopsis*, *Querques*, etc.) and deciduous species (*Betula*) and evergreen undergrowth.

11. **Moist Temperate Forest.**—Evergreen forests of Conifers or Oaks, etc., or mixture of both. Undergrowth rarely dense and partly deciduous.

11a. Lower Oak-conifers. Deodar with some Blue-pine in the west, *Tsuga* in the east. *Quercus incana* in the west and *Q. lineatus*. *Q. lamellosa* in the east.

11b. Middle Oak Coniferous. Spruce, Deodar and some fir in the west; *Ysuga* and spruce in the east. *Q. dilatata* in the west and *Q. pachyphlla* in the east.

11c. Upper Oak-Conifersous. *Abies* with *Quercus semecarpifolius* in the west and *Q. pachyphylla* in the east.

12. **Dry Temperate Forest.**—Open evergreen forest with open scrub undergrowth. Deodar, Pine and Juniper with Xerophytic broadleaved trees including *Quercus ilex*.

(Temperate Deciduous Forest). Mixed deciduous forest very similar to European deciduous forest. Apparently an edaphic climax or seral stage.

(Alder Woods). More or less pure crop of *Alnus* on riverain sites.

(Temperate Bamboo Brakes). Due to destruction of the overwood.

V. Alpine Forest and Scrub.

13. **Alpine Forest.**—Evergreen Conifers, and mainly evergreen low broad-leaved trees.

- 13a. Birch-Fir. A fairly dense mixed of high level fir and deciduous Birch with evergreen (Rhododendron) and deciduous undergrowth.
- 13b. Birch-Rhododendron. Low tangled forest, often dense, of evergreen Rhododendrons with or without a deciduous Birch overwood.
14. **Moist Alpine Scrub.**—Often dense, mainly evergreen scrub of dwarf Rhododendrons, Juniper, etc.
15. **Dry Alpine Scrub.**—Open xerophytic scrub of Artemisia, Eurotia, Potentilla, etc.

Botanical Areas.

Areas Recognized:—Comparison of the recorded floras of the various parts of the country has led to the recognition of a number of Botanical areas each with characteristic features. The following are the areas:—

- (1) East Himalayan.
- (2) West Himalayan.
- (3) Indus Plain.
- (4) Gangetic Plain (divisible into dry, humid and tidal areas.)
- (5) Malabar (West Coast generally).
- (6) Deccan (Peninsular India, divisible into Northern or Central India, and Southern or Deccan with Carnatic).
- (7) Burma.

Now if the floras of these areas are compared with those of adjacent countries, affinities are brought about suggesting the probable origin of the differences.

It is evident that there is no "Indian Flora" as a separate entity, but our vegetation is compounded of several elements

which are present in different proportions in the different areas. These elements are, in order of dominance for the country as a whole:

- (1) Malayan. (2) European and Oriental (meaning the near east). (3) African (or better Indo-African).
- (4) Tibetan and Siberian, practically confined to the Himalayas and (5) Chinese and Japanese mainly in Burma and the Himalayas.

HISTORY OF FOREST FLORA.

Present and Geological.

Present distributions and geological history suggests that the oldest elements in time is the Indo-African, including various Combretaceae, Acasiarabica, *A. Catechu* and *Zizyphus jujuba*, which is common to tropical Africa, Madagascar and India, and that it extends to the West Himalayas in later periods. In Burma and Assam, the Malayan element, exemplified by the *Dipterocarpus*, *Myrtaceae*, *Garcinia*, *Tectona*, *Schleichera* and *Dillinia*, may be nearly as old, and it probably extends westwards in about Miocene times, with indications that there must then have been a much easier route for spread to South India than now exists, such as direct connection from Malaya to Ceylon and Malabar. It may be noted that Ceylon has a number of most interesting endemic *Dipterocarps*. Tibetan element consists mainly of alpine herbs and shrubs (*Hippophae rhamnoides*) and must have existed along the northern limits of the country since the Himalayas reached a height of some 12,000 feet, and has extended widely in later Tertiary times. The Sino-Japanese element includes many *Ternstroemiaceae* such as *Schima*, *Altingia*, *Rhododendron*, *Engelhardtia*, *Tsuga*, and many oaks such as *Q. semecarpifolius serrata*, *Q. glauca*, and has similarly worked westwards and southwards. The

European element soon followed the Tibetan, extending rapidly from the west eastwards and down into Burma. It is well illustrated by some oaks, notably *Q. ilex*, *Juniperus* sp. *Cratagus*, and *Cedrus*.

It is of interest to note the presence of a few typically Australian genera in India, such as the coastal *Casuarina*, the commonly planted ornamental tree, *Melaleuca* (though this only reaches Mergui in the wild state), and the genus *Helicia* (*Proteaceae*) represented by various species in all the moist parts of the country.

GEOGRAPHICAL DISTRIBUTION OF THE CHIEF FOREST TYPES.

1. **Tropical Wet Evergreen Forest:**—This type is found along the Western face of Western Ghats, in a strip extending south-west from upper Assam through Catchar and southwards through the Chitagong Hill tracts and along the Arakan Coast, and in a strip from North Burma down the Salween Valley and the coast to Tennesserim with a Westward extension across the Irrawady delta linking it with the Arakan Coast strip. This corresponds with regions with 100 inches rainfall.

2. **Tropical Semi-evergreen Forest:**—Adjoins the tropical evergreen, forming a transition to the latter from the moist deciduous, much influenced by human activities. Much-developed Southern part of Pegu Yoma in Burma and locally along the Western Ghats, whilst a northern form occupies considerable areas in Assam and the lower slopes of the Eastern Himalays.

3. **The Tropical Moist Deciduous Forests:**—This and the following is referred to as Monsoon Forest the most characteristic type of India. It occurs as a strip along

the foot of the Himalayas, another strip along East side of the Western Ghats, a large block centring the Chota Nagpur, a wide ring round the dry zone of Upper Burma, and a tract to the left of Khasi Hills. Rainfall 60 to 80 inches with a dry season of four to six months. The moist Sal Forests from the greater part of the Northern half of the range and moist teak is equally typical of the Southern half. Throughout the area, more or less open Savannah forest, ascribable to the Biotic factors, is found.

4. **Tropical Dry Deciduous Forests** occurs in an irregular wide strip from North to South of the country from the foot of the Himalayas to Cape Comorin, bounded on the North-West by the Sind Desert, on the South-West by the Western Ghats and on the East by the wetter Forests of Bengal. It is also found over a relatively small area in Burma, where the typical rainfall of 40 to 50 inches with a dry season of six months occurs. Sal and Teak Forests are again typical, but are of much inferior type to the Moist deciduous, and these important trees are wanting over a large area.

5. **Tropical Thorn Forest** occupies a big strip in the Indus basin in South Punjab, Rajputana, and Sind where the rainfall is about 10 to 30 inches, and is also found over large areas in the upper Gangetic Plane and the Deccan Plateau, as well as in the dry zone of Upper Burma.

6. **Tropical Dry Evergreen Forest** is confined to a relatively small area on the Carnatak Coast.

7. **Sub-Tropical Wet Hill Forest** is limited to the lower slopes of the Himalayas in Bengal and Assam, and local occurrences on other hill ranges, such as Khasi, Nilgiri, Mahableshwar Hills and the Shan Plateau in Burma.

8. **Subtropical Pine Forest** is constituted by the Chir pine Forests found between three and six thousand feet throughout

the Central and Western Himalayas, and local occurrences of other pines in the Khasi Hills and Burma at corresponding elevations.

9. **Sub-Tropical Dry Evergreen Forest** is only found in the North-West corner of the country.

10. **Wet Temperate Forests** are characteristic of the Eastern Himalayas between 6,000 and 9,500 feet, and also occur on the top of the Hills of South India and North Burma.

11. **Moist Temperate Forests** are found between 5,000 and 10,000 feet in Central and Western Himalayas except where the rainfall falls below 40 inches in the inner ranges, especially in the North-West. The occurrence of Oak or Coniferous Forests depends on minor local variations of conditions.

12. **Dry Temperate Forests** occur on to inner ranges of the Himalayas, throughout the length and are best represented in the North-West.

13. **Alpine Forest** occurs throughout the Himalayas above about 10 thousand feet up to Timber limit.

CHAPTER XIX

FOREST VEGETATION OF INDIA.

Forest Vegetation and Climatic Conditions at or in the Neighbourhood of Dehra Dun.

Situated in a valley between the outer ranges of the Himalayas and the outlining Siwalik Hills, at an elevation of about 2,200 feet, with a comparatively heavy rainfall, Dehra Dun forms in many respects, an admirable centre for the conduct of experimental work dealing with species differing widely in geographical distribution and climatic range. The

surrounding forests are composed largely of Sal (*Shorea robusta*) with many miscellaneous species found in the Indian Peninsula, North-Eastern India, or Burma, among which are the following:—

Anonaceae.—*Miliusa velutina*.

Malvaceae.—*Kydia calycina*, *Bombax malabaricum*.

Sterculiaceae.—*Sterculia villosa*, *Pterospermum acerifolium*.

Rutaceae.—*Ægle marmelos*.

Burseraceae.—*Garuga pinnata*.

Meliaceae.—*Cedrela Toona*.

Rhamnaceae.—*Zizyphus Jujuba*, *Z. Xylopyrus*.

Sapindaceae.—*Schlechira trijuga*.

Anacardiaceae.—*Buchanania latifolia*, *Semecarpus Anacardium*, *Mangifera indica*, *Odina woodier*, *Spondias mangifera*.

Leguminosae.—*Dalbergia Sissoo*, *Ougenia dalbergioides*, *Erythrina suberosa*, *Butea frondosa*, *Bauhinia racemosa*, *Cassia fistula*, *Bauhinia malabarica*, *B. purpurea*, *variegata*, *Acasia Catechu*, *Albizzia odoratissima*, *A. procera*, *A. stipulata*.

Rhizophoraceae.—*Carrallia lucida*.

Combretaceae.—*Terminalia belerica*, *T. Chebula*, *T. tomentosa*, *Anoguissus latifolia*.

Myrtaceae.—*Eugenia jambolana*, *E. operculata*, *Careya arborea*.

Lythraceae.—*Lagerstroemia parviflora*.

Samydaceae.—*Casearia glomerata*, *C. tomentosa*.

Rubiaceae.—*Adina cordifolia*, *Stephegyne diversifolia*, *Hymenodictyon excelsum*.

Ebenaceae.—*Diospyros Embryopteris*.

Apocynaceae.—*Carrissa spinarum*, *Alstonia schloris*, *Holarhina antidyssentrica*, *Wrightia tomentosa*.

Boraginaceae.—*Cordia myxa*, *Ehretia levis*.

Bignoniaceae.—*Oroxylon indicum*, *Stereospermum suaveolens*.

Verbenaceae.—*Gmelina arborea*.

Lauraceae.—*Litsaea sebefera*, *L. polyantha*.

Euphorbiaceae.—*Bridelia retusa*, *Phyllanthus Emblica*.

Bischoffia javanica, *Trewia nudiflora*, *Mallotus phillipensis*.

Ulmaceae.—*Holoptelia integrefolia*.

Moraceae.—*Ficus benghalensis*, *F. Rumphii*, *F. Cunia*, *F. Glomerata*, and other species.

Salicaceae.—*Salix tetrasperma*.

The typical sub-Himalayan species *Dalbergia sisso* is abundant in riverain tracts. Certain species usually characteristic of tropical forest, for instance *Carallia lucida* and *Calamus tenuis*, occur naturally in swampy localities in the neighbourhood of Dehra Dun. On the other hand, certain Himalayan species which ascend to 6,000 feet or more also occur naturally in Dehra Dun valley, for instance *Pyrus Pashia*, *Ficus palmata*, and in swampy localities *Acer oblongum*, *Quercus incana*, and *Celtis australis*. Certain trees of the temperate Himalayas have been planted at Dehra Dun; *Cupressus torulosus* and *Q. incana* grow well, the latter regenerating naturally with freedom, while the Deodar and blue-pine grow fairly well for a time, though they do not attain large dimensions and fail to ripen their seeds. *Pinus longifolia* flourishes, growing rapidly and regenerating naturally where conditions are favourable. At the same time many trees of the warmer regions thrive very well when introduced, for instance *Dillinia indica*, *Lagerstroemia Flos-Reginae*, *Albizzia lucida*, *Tectona grandis*, *Sterculia alata*, *Mimusops Elengii*, *Amoora Rohituka*, *Saraca indica*, *Michelia Champaca*, *Dalbergia latifolia* and others, while

among Burmese trees *Xylia dolabriformis*, *Dalbergia cultrata*, *D. Oliveri*, and *Lagerstroemia tomentosa* have recently been introduced and show some promise. The more tender tropical trees, however, do not stand the winter cold at Dehra Dun. The normal rainfall at Dehra Dun, the mean of 33 years is 85.22 distributed as follows: January 2.27, February 2.33, March 0.98, April 0.70, May 1.48, June 8.42, July 27.00, August 30.55, September 9.43, October 0.89, November 0.30, December 0.87.

FOREST VEGETATION OF INDIA.

For our purposes it will be convenient to recognize twelve different regions:—

1. The Western Himalayan Region.
2. The Eastern Himalayan Region.
3. The Trans-Indus Region.
4. The North-Western Dry Region.
5. The Gangetic Plane.
6. The West Coast Region.
7. The Central India Region.
8. The Deccan and Carnatic.
9. Assam, 10. Chittagong and Arakan, 11. Burma, and 12. The Andamans.

1. **The Western Himalayan Region.** This region comprises the sub-Himalayan tract and the Himalayan Range from Kumaun to Chitral, it is characterized by a rainfall varying for the most part from 40 to 80 inches, though in some parts of the sub-montane tracts, it reaches 100 inches, or more, while in the inner valleys and towards the North-West frontier the climate is dry or even arid. This region is divisible into three zones of altitude:

- (a) The sub-montane zone and lower hills, up to about 5,000 feet.

- (b) The temperate zone, from about 5,000 to 11,000 feet.
- (c) The alpine zone, from 11,000 to 12,000 feet up to about 15,000 feet.

(a) The sub-montane tract contains almost continuous belt of sal forest running with occasional breaks, throughout the eastern portion of the tract as far west as the Jumna, and to very small extent beyond; details of this sal belt which extends into the Sub-Himalayan valleys and ascends the outer hills in places, will be found under *Shorea robusta*. The sal belt is broken at intervals by savannah lands with scattered trees, chiefly *Butea frondosa* and *Bombax malabaricum*, or by different types of forest, for instance (i) Riverain forests of *Acacia Catechu* and *Dalbergia sissoo*; (ii) Swamp forests of *Eugenia Jambolana*, *Diospyros Embryopteris*, *Albizzia procera*, *Ficus glomerata*, *Bischoffia javanica*, *Pterospermum acerifolium*, *Cedrela Toona*, *Celtis australis*, *Trewia nudiflora*, *Putranjiva Roxburghii*, *Salix tetrasperma*, and other trees with the cane *Calamus tenuis*; (iii) Dry Thorn Forests of *Zizyphus Jujuba*, *Z. xylopyrus*, *Acacia Catechu*, and others; (iv) Mixed Deciduous Forests, containing *Terminalia* sp. *Bombax mamabarium*, *Lagerstroemia parviflora*, *Anoguissus latifolia*, *Steriospermum suaveolens*, *Phyllanthus Emblica*, *Adina cordifolia*, *Ougenia dalbergioides*, *Odina Woodier*, *Hymenodictyon excelsum*, *Holoptelia integrifolia*, *Cassia fistula* and many other species. These mixed forests ascend the outer hills to between 3,000 and 4,000 feet, the Bamboo *Dendrocalamus strictus* occurring in great abundance in places on the lower slopes. As the elevation increases new species such as *Bauhinia retusa*, *Sapium insigne*, *Englehardtia spicata*, *Bochemiria rugosa*, *Pistacia integerrima*, and *Euphorbia Royleana* make their appearance, while some of the trees of the lower elevations are no longer found: finally *Pinus longifolia* appears, at first scattered among other species but soon forming extensive pure

forests towards the upper limit of this zone. In the western part of his region, in the Jhelum and Rawalpindi districts and in the North-Western Frontier Provinces, the forest becomes drier in character, the prevailing species in the sub-montane tracts and outer hills being *Acasia modesta*, *Olea cuspidata*, *Carissa spinarum*, *Dodonea viscosa*, and other xerophytic species.

(b) The temperate zone, which begins at about 5,000 feet contains extensive forests of Conifers and broad-leaved trees. Of the former *Pinus longifolia* enters the zone, but is confined to the lower elevations and soon gives place to Deodar (*Cedrus Deodar*) and Blue Pine (*Pinus exelsa*), while higher up Spruce (*Picea Morinda*) and Silver Fir (*Abies Pindrowi*) make their appearance and form forests of large extent, mainly between 8,000 and 11,000 feet; of other Conifers the Yew (*Taxus baccata*) is common in some localities, while the Cypress (*Cupressus torulosus*) is found locally, and the edible Pine (*Pinus Gerardiana*) occurs in the inner dry valleys. The broad leaved trees comprise oaks, of which *Q. incana* and *dilatata* and *semecarpifolius* are the chief, with *Q. Ilex* in the drier valleys. Maples, horse-chestnut (*Aesculus indica*), Poplar (*Populus ciliata*) Elm (*Ulmus Wallichiana*), being the chief Alder (*Alnus nepalensis*) and *A. nitida*, the latter descending below the zone, Birch (*Betula alnoides*) *Cornus prunus*, *Padus*, *Rhododendron arboreum*, and other trees.

(c) The alpine zone extends from 11,000 to 12,000 feet up to about 15,000 feet or some times higher. The characteristic trees are the high level Silver Fir, the Silver Birch (*Betula utilis*), and junipers. *Rhododendrons* are far less, numerous than in the eastern Himalayas, and are represented by these shrubby species.

2. **The Eastern Himalayan Region.** This region extending from Sikkim eastwards, embraces the humid portion of the

Himalayan Range. Nepal, owing to want of knowledge of its forest flora, constitutes a gap between the western and eastern region as here defined. The Eastern region may be divided into three zones of altitude:

- (a) The Tropical Zone, up to about 5,000 feet.
- (b) The Temperate Zone, from 5,000 to 12,000 feet and
- (c) The Alpine Zone, from 12,000 feet to 16,000 feet.

(a) The Tropical Zone begins with a forest belt stretching some distance out into the plains and consisting of several different types of forest, the chief of which are: (i) Sal forests, including the Sal savannah tracts in which the dominant grass is *Saccharum Narenga*; (ii) Riverain forests *Dalbergia Sissoo* and *Acasia Catechu*; (iii) Mixed deciduous forests of *Terminalia* sp. *Lagerstroemia parviflora*, *Sterculia villosa*, *Bombax malabaricum*, *Duabanga sonneratioides*, *Anthocephalus Cadamba*, *Schima Wallichii*, *Gmelina arborea*, *Cedrela Toona*, *Albizzia procera*, *Premna*, *Bauhunia*, *Steriospermum*, etc.; (iv) Moist savannah forests, consisting of stretches of tall savannah grasses of which *Saccharum procerum* is among the commonest, with scattered trees among the chief of which are *Albizzia procera*, *Bombax malabaricum*, and *Bischoffia javanica*; (v) Evergreen forests with a large number of species, among which are *Michelia Champaca*, *Schima Wallichii*, *Artocarpus chaplasha*, *Dillinia indica*, *Talauma Hodgsoni*, *Aeschulus punduana*, *Ammoora*, *Eugenia*, *Echinocarpus*, *Eurya*, *Garcinia*, *Eleocarpus*, *Cinnamomum*, *Cecidodaphne*, *Canarium sikkimsis*, and *Ficus elastica*, the last named now rare; there are numerous canes, climbers and evergreen shrubs forming a dense impenetrable undergrowth.

In the outer hills, Sal, where present, occurs chiefly on the ridges, the intervening depressions and valleys being occupied by moist mixed forests in which the Bamboo *Dendrocalmus*

Hamiltonii is often abundant. In the upper part of this Zone two characteristic trees, *Betula cylindrostachys* and *Alnus nepalensis* make their appearance.

(b) The Temperate Zone from 5,000 to 12,000 feet may be divided into two belts: (i) The lower belt below 9,000 feet, containing a large number of different broad-leaved species, including *Q. lamellosus*, *lineata*, *pachyphylla*, and other oaks, *Castanopsis*, *Michelia excelsa*, and other Magnoliaceae, *Bucklandia populnea*, *Cedrela*, many laurels and maples, Alder, Birch, *Pyrus*, *Symplocos*, *Echinocarpus*, *Eleocarpus*, *Maliosma*, and *Eurya*; (ii) The Upper Hill Forests, above 9,000 feet, consisting for the most part of Conifers, *Abies Webbiana*, *Picea spinulosa*, *Larix Griffithi*, *Tsuga Brunoniana*, and two *Junipers* as well as numerous *Rhododendrons*, dwarf willow and other shrubs; the Bamboo *Arundinaria racemosa* forms a dense growth in places.

(c) The Alpine Zone, above 12,000 feet, is rich in *rhododendrons*, which ascend to 16,000 feet; the *junipers* of the upper temperate zone also extend high into this zone.

3. **The Trans-Indus Region.** This region comprises, the trans Indus Hills of the North-West Frontier Provinces and Baluchistan. In the northern part of this region, extending southward as far as the Kurram Valley, the forests approximate in type to those of the western portion of the western Himalayan Region. Farther south in Baluchistan, where the rainfall does not exceed 12 inches and is often considerably less, most of the Himalayan Conifers disappear, and the forests become much drier and poorer in type; *Pinus excelsa* is very local in the North of Baluchistan, being confined to places where moisture is held up in the soil, while *Pinus Gerardiana* forms forests of some extent, as in Zhoab and in the Takht-i-Suleman. The chief Conifer of Baluchistan is *Juniperus macropodam* which forms somewhat open forest. Among other trees or shrubs of

this region may be mentioned *Pistacia mutica*, *P. Khinjak*, *Fraxinus xanthoxyloides*, *Olea cuspidata*, *Acasia modesta*, *Tamarix* sp., *Crataegus Oxycantha*, and *Tecoma undulata*. In some parts of the trans-Indus region, the small gregarious Palm *Nannorhops Ritchieana* occurs in tracts of considerable extent.

4. **The North-Western Dry Region.** This region comprises the plains of the Punjab and Sind, Rajputana, Cutch, and the Northern part of Gujerat. The rainfall is less than 30 inches, and in most parts of the regions is under 20 inches, while in the driest parts of Sind less than 5 inches of rain fall in the year. In the extreme north of this region, on the hills an elevated plateau between the Jhelum and the Indus, the dominant species are *Acasia modesta* and *Olea cuspidata*, with most of the shrubs characteristic of the Sub-Himalayan tract to the north. On proceeding south, vegetation diminishes towards the desert regions of the southern Punjab, Sind, and Rajputana, and almost disappears in the driest parts. Tree vegetation here exists mainly along the rivers, where land is subject to periodical inundation. These riverain forests are well exemplified along the Indus in Sind, where there are extensive areas covered with *Acasia arabica*, *Prosopis specigera*, *Populus euphratica*, and *Tamarix*. The natural forests of the dry plains of the Punjab, Sind Rajputana, where they have not been destroyed for cultivation, consist of *Prosopis specigera*, *Salvadora oliodes*, and *Capparis aphylla*, forming a very open growth. These species rapidly disappear with the extension of irrigation, their places being taken by such trees as *Acasia arabica*, *Albizzia Lebbeck*, *Dalbergia Sissoo*, and others which have escaped from cultivation. To the south-east of this region lie the Aravally Hills and their outliers, commencing with a few isolated rocky hills in the south of the Punjab. Here the desert flora of the dry plains give place to dry and somewhat open types of forest consisting in places almost entirely of

Anoguissu pendula. Other characteristic species of these hills and the adjacent tracts are *Boswellia serrata*, *Sterculia urens*, *Grewia salvifolia*, *G. pilosa*, *Balanites Roxburghii*, *Acacia Senegal*, *A. leucophloea*, *A. Jacquemonti*, *Catechu*, *Dichrostachys cinera*, *Balsamodendron Mukul*, *Zizyphus nummularia*, and *Euphorbia Nivulia*. These forests are for the most part typical thorn forests.

5. **The Gangetic Plain.** The great bulk of the Gangetic plain is a cultivated tract. The forests where they exist, are of widely different types. The extreme south-west of this region borders on the Aravalley Hills, and the forest vegetation is of the type just described. The Ravine country south of the Jumna contains open thorn forest of *Acacia arabica*, *A. leucophloea*, and other species. The two most important tracts of this region are the Sal forests of Oudh and the Littoral and Tidal forests of the Sunderbans. The Oudh Sal Forests as they exist now, are probably mere remnants of the great sub-Himalayan Sal belt, which at one time covered a much larger area than it does at present and stretched for some distance into the plains; strictly speaking they can hardly be differentiated from the sub-Himalayan "Tarai" Forests. These forests are described under *Shorea robusta*. The Sunderbans form an extensive forest tract occupying a flat plain of recent alluvial origin, and still in process of formation, in the southern portion of the Gangetic Delta, bordering on the Bay of Bengal. The chief species of this tract are *Heritiera Fomes*, *Exeacria Agallocha*, *Sonneratia apetala*, *S. acida*, *Carapa molluccensis*, *C. obovata*, *Amoora coculata*, *Aegecerus majus*, *Cynometra ramiflora*, *Avicennia officinalis*, and the Mangroves *Ceriops Candoleana*, *C. Roxburghi*, *Kandelia Rheedii*, *Rhizophora mucronata*, and *Bruguiera gymnorhiza*.

6. **The West Coast Region.** This region which is one of heavy rainfall, comprises the exclusively humid belt of moun-

tainous country running parallel to the west coast of the Indian Peninsula from the south of Gujerat to Cape Comorin, together with the low country between the mountain and the coast. Owing to a gap separating the Mountains of Travancore from those to the North of them, the flora of this region is carried some distance across the Peninsula at this point. Broadly speaking the forests of this region may be divided into three main types:

- (a) Tropical Evergreen or Rain Forest.
- (b) Mixed Deciduous or Monsoon Forests, and
- (c) Sub-Tropical or Temperate Evergreen Forests of the Nilgiris and other mountains of Southern India.

(a) The Tropical or Rain Forests are characterized by the great luxurience of their vegetation, which consists of several tiers, the highest containing lofty trees, often with buttressed bases, reaching a height of 150 feet or more, and the lowest consisting of a dense shrubby evergreen undergrowth. The intermediate tiers consist mainly of evergreen trees crowded together and struggling for light. There is a luxurient growth of climbers, while the trees are covered with numerous epiphytes. The rain forests of the west coast region are found mainly from North Kanara southwards; much of the forest, however, has been either destroyed by shifting cultivation or cut up by spice and betel-palm gardens, or in the south by Rubber plantations. Among the trees of the evergreen forests are *Dipterocarpus indicus*, *Hopea parviflora*, *H. Wightii*, *Callophyllum tomentosum*, *Callunia excelsa*, *Dichopsis Lelliptica*, *Dysoxylon malabaricum*, *Cedrela toona*, *Vateria indica*, *Canarium strictum*, *Tetramelis nudiflora*, *Mesua ferrea*, *Mangifera indica*, *Sterculia alata*, *Artocarpus hirsuta*, *A. integrifolia*, *A. Lakoocha*, *Acrocarpus fraxinifolius*, *Hydnocarpus Wightiana*, and many *Myristicaceae* and *Lauraceae*.

(b) The mixed deciduous and Monsoons Forests are composed mainly of deciduous trees, which are more or less leafless for a considerable portion of the dry hot season from December up to May or June. These forests are rich in climbers but are not so dense as the evergreen forests, nor do they contain such lofty trees. Among the principal species are: *Tectona grandis*, *Dalbergia latifolia*, *Terminalia tomentosa*, *T. paniculata*, *T. belerica*, *Lagerstroemia lanceolata*, *L. parviflora*, *Pterocarpus*, *Marsupium*, *Xylia xypocarpus*, *Adina cordifolia*, *Stephegyne parviflora*, *Grewia tiliifolia* and others: the chief Bamboos are *Bambusa arundinacea*, *Dendrocalamus strictus*, and *Oxytenanthera monostigma*, the last named on the upper slopes.

(c) The Sub-Tropical or Temperate Evergreen Forests, known locally as "Sholas", commence at about 5,000 feet and are characteristic features of the landscape of the Nilgiri, Anaimalai, Palni, and other Hill Ranges of Southern India.

Among the more characteristic trees are *Michelia Nilgirica*, *Ternstroemia japonica*, *Eurya japonica*, *Gordonia obtusa* with species of *Eugenia*, *Ilex*, *Meliosma*, *Euonymus*, *Symplocos*, *Glochidion*, and various other Lauraceae.—The undergrowth is of various species of *Strobilanthus*.—The two common Bamboos of these hills are *Arundinaria Wightiana* and *Oxytenanthera Thwaitesii*.

There are other types of forests such as: (i) Mangrove forests along the tidal creeks; (ii) littoral forests of *Callophyllum Inophyllum*, *Anacardium occidentale*, *Salvadora persica*, *Erythrina indica*, *Ficus tomentosa*, and *Pongamia glabra*.

7. **The Central Indian Region.** This region comprises the country between the Gangetic Plane on the North and the Godaverri river on the south, and includes the whole of the Central Provinces, Chota Nagpur, Orissa and the Circars, Khandesh, the southern part of Gujerat, and the greater part

of Central India States. Within this range fall the two great hill ranges of Central India, the Vindya and the Satpura Range. The rainfall varies from 25 to 65 inches, except that the latter is exceeded on the Plateaux of Pachmarhi and Chikalda. The great bulk of the forests of this region consists of either (A) Mixed Deciduous Forests or (B) Sal Forests or (C) Thorn forests.

(A) The Mixed Deciduous Forest. The prevailing trees are *Tectona grandis*, *Terminalia tomentosa*, *T. belerica*, and *Chebula*, *Anoguissus latifolia*, *Lagerstroemia parviflora*, *Pterocarpus marsupium*, *Dalbargia latifolia*, *Ougenia dalbergioides*, *Cassia fistula* *Acasia* *Catechu*, *Butea frondosa*, *Adina cordifolia*, *Stephegyne diversifolia*, *Bridelia retusa*, *Phyllanthus Emblica*, *Cleistanthus collinus*, *Diospyros Melanoxylon*, *Bassia latifolia*, *Soymeda febrifuga*, *Schrebera swietenoides*, *Chloroxylon Swietenia*, *Odina Woodier*, *Buchanania latifolia*, *Schleira trijuga* and various other trees.—*Dendrocalamus strictus* is the Bamboo there.—In dry situations *Boswellia serrata*, *Sterculia urens*, and *Cochlospermum Goossypium* are the chief species.

(B) The Sal forests extend through the eastern part of the Central Provinces, the greater part of Chota Nagpur and Orissa, and the North-Eastern portion of the Madras Presidency.

(C) The thorn forests are in the drier parts of this region particularly in Central India—Common plants are:—*Acasia arabica*, *A. leucophloea*, *A. Catechu*, *Dichrostachys cinera*, *Balanites Roxburghi*, *Butea frondosa*, *Phyllanthus Emblica*, *Zizyphus zylopyrus*, *nummulatia* and *Oenoplia*. *Prosopis specigera* occurs only in the driest parts of this region.

8. The Deccan and Carnatic. This region includes the whole of peninsular India south of the Godaveri with the exception of that portion which falls into the humid West Coast region. It is divisible into two regions (a) The elevated

and often hilly plateau of the Peninsula which may be termed the Deccan sub-region, and (b) the low land along the east coast (Coromandal), which may be termed the Carnatic sub-region. The rainfall is 40 to 60 inches (except Yarcan 60 in.).

(a) The Deccan sub-region has dry open forests containing the following *Prosopis specigera*, is plentiful, *Acacia planiformis*, *A. latronum*, *Albizzia amara*, *Cassia auriculata*, is a conspicuous shrub, Fleshy *Euphorbiaceae*, *Capparis divaricata*, *C. aphylla* are the Xerophytic types. Among the many special types of forests are the following *Hardwickia binata*, *Anogonissus latifolia*, *Soymeda febrifuga*, *Terminalia tomentosa*, and other trees. *Pterocarpus santalinus* is mainly to be found in the hills of Cuddapah and North Arcot, and in the hills of Chingleput. *Dalbergia latifolia*, *Pterocarpus marsupium*, *Albizzia odoratissima*, and other trees are also found.

(b) The Carnatic sub-region contains, besides a certain extent of forest of the Deccan type, another type which may be termed **Dry Evergreen**, in which the chief species include *Mimusops hexandra*, *M. elengii*, *Diospyros Ebenum*, *Strychnos nux-vomica*, *Eugenia* sp., *Pterospermum suberifolium*, *P. Heyneanum*, *Mammycelon edule*, and *Chlorozylon Sweitenia*. In the thorny region *Randia*, *Canthium*, *Dichrostachys*, *Flacourtia*, and *Zizyphus* are found, while near the sea *Foenix farinaria* and the grass *Spinifex squarrosus* form dense thickets. *Casuarina* is common on the sandy coast.

9. **Assam.** The Assam region outside the sub-Himalayan tract which forms part of the Eastern Himalayan region, comprises the Brahmaputra and the Surma Valleys together with the intervening hill ranges (The Garo, Khasi, and Jaintia Hills) and the Naga, Manipur and Lushia hills on the eastern and southern frontiers of Assam. Rainfall is about 80 inches while Cherrapunji in the Khasi Hills has a rainfall of 460 inches. In

parts of Naongaon District it falls to 45 inches. Among the more characteristic species of the valleys and lower hills are:—*Mesua ferrea*, *Artocarpus*, *Chaplasha*, *Michelia Champaca*, *Lagerstroemia Flos-Rigina*, *Amoora Wallichii*, *Vatica lanceaefolia*, *Alstonia scholaris*, *Cinnamomum Cecidodaphne*, *Dillenia indica*, *Dysoxylon benectariferum*, *Garcinia* sp., *Eugenia* sp., *Carallia lucida*, *Baccaurea sapida*, *Aquilaria Agallocha*, *Sterculia alata*, *Cedrela toona*, *Gmelina arborea*, *Morus laevigata*, *Stereospermum chelonoides*, *Ficus elastica* and many other species. There are various Bamboos, *Dendrocalamus Hamiltonii* is the commonest, and there is a dense impenetrable undergrowth of Canes, climbers, and evergreen shrubs. In the Riverain areas the following are common:—*Albizzia procera*, *Bischofia javanica*, *Bombax malabaricum*, *Anthocephalus Cadamba*, *Eleocarpus assamicus*, and *Lagerstroemia Flos-Rigina*, South of the Brahmaputra Sal Forests occur in the Garo Hills and in the Kamrup district.

The Hill Forests of Assam include the following *Magnolia*, *Mangleitia*, *Michelia*, *Acer*, *Prunus*, *Pyrus*, *Pieris ovalifolia*, *Rhododendron arboreum*, *Bucklandia populnea*, *Alnus nepalensis*, *Betula alnoides*, *Carpinus viminia* and many species of *Quercus*. The pine forests occur at 2,500 and above particularly at 4,000 to 5,000 feet and are composed of *Pinus Khasya*. The hill tops of the Assam region are open grassland with trees and shrubs closely related with those found at the Nilgiri.

10. **Chittagong and Arakan.** The heavy rainfall varies from 96 to 200 inches. Along the coast of Arakan, there are extensive Mangrove swamps, while stripes of *Casuarina equisetifolia* occur here and there. In the evergreen forests occur the following:—*Mesua ferrea*, *Dipterocarpus* sp., *Vatica*, *Hopea odorata*, *Sterculia alata*, *Dysoxylon binectariferum*, *Chukrasia tabularis*, *Cedrela Toona*, *Acrocarpus fraxinifolius*, *Swin-*

tonia floribunda, Buchanania lancifolia, Carralia indica, Eugenia sp. Machilus sp. Baccaurea sapida, Tetramelis nudiflora, and Artocarpus Chaplasha. Palms including Canes are numerous. Quercus and Castanopsis are also found.

The mixed deciduous forests contain the following:—*Dillinia pentagyna*, *Miliusia velutina*, *Pterospermum semisagittatum*, *Erythrina stricta*, *Xylia dolabriformis*, (Arakan) *Albizzia stipulata*, *Bombax malabaricum*, *Terminalia*s, *Anogonissus acuminata*, *Lagerstroemia Flos-regina*, *Duabunga sonneratioides*, *Adina cordifolia*, *Stephegyne parviflora*, and *diversifolia*, *Homalium tomentosum*, *Vitex peduncularis*, and *glabrata*, and many others. *Melocanna bambusoides* covers immense tracts in the hills of Chitagong and Arakan.

II. **Burma.** The Burmese region, which is here taken to mean the whole of Burma including the Shan States but excluding Arakan, may be divided roughly into three zones of rainfall corresponding approximately to three dominant forest types or Climatic Forest Formations; these Zone are:—

A. The Humid Zone. B. The Medial Zone. C. The Dry Zone.

A. The Humid Zone:—With a rainfall of 120 inches comprises Tennesserim and Martaban with the country east of the Sittang river up to about 19 degrees N. latitude and perhaps in part also the Salween drainage farther north; also probably the far north of Upper Burma.

B. The Median Zone:—With a rainfall of 40 to 120 inches comprises the greater part of Pegu and of Upper Burma outside the dry zone on the one hand and the humid tracts of the far north on the other. The dominant forest type is the mixed deciduous type.

C. The Dry Zone:—With a rainfall of less than 40 inches comprises the dry tract occupying the centre of the southern

part of Upper Burma and extending into the Thayetmyo district of Lower Burma.

A classification of the forests of Burma is by no means easy but the following classification may be adopted here for brief descriptive purposes:—

- (a) Tidal Forests. (b) Beach and Dune Forests. (c) Swamp Forests. (d) Tropical evergreen or Rain Forests. (e) Dry evergreen Forests. (f) Sub-Tropical or Temperate evergreen Forests. (g) Mixed Deciduous Forests. (h) Deciduous Dipterocarp Forests. (i) Thorn Forests. There are various types of Savannah forests, but they must be included in one or other of these main classes, into which they usually merge.

(a) The Tidal Forests comprise Mangrove Forests on low alluvial flats within tidal limits at the mouth of the rivers which contain true Mangroves of the genera *Rhizophora*, *Kandelia*, *Ceriops* and *Bruguiera* together with *Carapa*, *Lumnitzera*, *Sonneratia*, *Aegicerus* and *Avicennia* together with the gregarious palm *Nipa fruticans*: (i) Forests further inland on ground inundated only by spring tides containing such species as *Heritiera Fomes*, *Pongamia glabra*, *Erythrina* sp., *Excaecaria Agallocha*, *Thespesia populnea*, some of the species of the mangrove forests, and the Palm Phoenix *paludosa*. These are usually called "Tidal Forests."

(b) Beach and Dune Forests are on the calcareous sand-beaches elevated above high-tide limits and on sand dunes formed by the action of the wind. *Casuarina equisetifolia* (on sand dunes). *Pongamia glabra*, *Erythrina indica*, *Thespesia populnea*, *Hibiscus tiliaceus*, *Callophyllum Inophyllum*. *Odina Woodier*, *Pandanus odoratissimus*, and others are usually found.

(c) Swamp Forests are characteristic of inland fresh water swamps on low-lying alluvial ground usually near rivers and lakes, and are subject to inundation during rainy season. These are *Barringtonia acutangula*, *Xanthophyllum glaucum*, *Anoguissus acuminata*, *Mangifera* sp., *Elaeocarpus hygrophilus*, *Eugenia operculata*, *Ixora parviflora*, *I. nigricans*, *Symplocos leucantha*, *Garcinia succifolia*, and others with a dense undergrowth of *Combretum trifoliatum* and *tetragonocarpum*, *Caparis tenera*, *Derris elegans*, and other shrubs and climbers. The higher ground is sometimes covered with tracts of coarse savannah grass.

(d) Tropical evergreen or Rain Forests are developed most extensively in Tenasserim and Martaban, where the rainfall for the most part exceeds 150 inches. These forests are similar to the evergreen forests of Western India and of the eastern Sub-Himalayan Tract. They are very rich in species, and comprise several tiers of vegetation, of which the uppermost consists of lofty and often deciduous trees, many of which have plank buttresses, the lower tiers consist mainly, if not entirely, of evergreen species struggling together in great profusion, while there is often a dense undergrowth of shade-bearing Palms; climbers including several kinds of canes are numerous, and sometimes form an impenetrable tangled mass. Where the cover is not too dense there is often a rich undergrowth of herbaceous plants or evergreen shrubs, and frequently a soil covering of ferns, but the overhead covering is so dense that nothing will grow in the deep shade beneath it. Several species of Bamboo are found in these forests, but in lower Burma perhaps the commonest is *Teinostachyum Helferi*, a straggling evergreen Bamboo which forms impenetrable thickets in moist localities. In Upper Burma *Dendrocalamus Hamiltonii* is common. Among the lofty trees are:—*Dipterocarpus alatus*, *D. turbinatus*, *Hopea odorata*, *Parashorea stellata*, *Sterculia alata*, *Tetramelis nudi-*

flora, *Acrocarpus fraxinifolius*, *Pentace burmanica*, *Swintonia floribunda*, and *Antiaris toxicaria*. Among other trees are:—*Artocarpus Chaplasha*, *Albizzia lucida*, *Magifera indica*, *Baccaurea sapida*, *Amoora Rohitooka* and species of *Eleocarpus*, *Holigarna*, *Pterospermum*, *Garcinia*, *Diopsyros*, *Eugenia*, *Macaranga*, *Ficus*, *Myristica* and many *Lauraceae*.

(e) Dry Evergreen Forests form a distinct xerophytic type. This occurs on the limestone rocks of the Ruby Mines districts, which consists of thorny evergreen species and *Euphorbias*.

(f) The sub-tropical and temperate evergreen forests of the hill regions of Burma, which begin at about 3,000 to 3,500 feet closely resemble the forests of Assam in the character of their forest vegetation which is essentially evergreen. The moist evergreen forests at elevations of 3,000 to 6,000 feet are sub-tropical or warm temperate character and there are many *Lauraceae*, *Ilex*, *Ternstroemia japonica*, *Bucklandia populnea*, *Ostodes paniculata* and others.

(g) The mixed deciduous forests, are economically speaking the most important forests of Burma, in that they are the home of the teak and many other valuable timber trees.

(i) The upper Mixed forests are situated on well-drained hilly or undulating ground, and usually characterized by the presence of Bamboos in quantity.

(ii) The lower Mixed forests occur on flat alluvial ground and are characterized generally by the scarcity or absence of Bamboos.

(iii) The Dry Mixed Forests are found where the rainfall is 35 to 60 inches and represents various transition forms between the mixed deciduous or Monsoon forest on the one hand and Thorn Forest on the other.

(h) The deciduous *Dipterocarp* Forests of Burma, locally known as "Indaing" are characteristic features of the forest

vegetation of the province, and cover large areas. *Dipterocarpus tuberculatus*, which grows gregariously is associated with *Pentacme suavis*, *Shorea robusta*, *Melanorrhoea usitata*, *Buchanania latifolia*, *Diospyros burmannica* and other trees. A soil covering of grass with shrubs such as *Indigofera*, *Flemingia*, *Desmodium*, and others.

(i) The thorn forests of Burma are practically confined to the dry zone where the rainfall varies from 23 to 40 inches. Among the commoner species are:—*Acacia Catechu*, *A. leucophaea*, *Dichrostachys cinerea*, *Tectona Hamiltoniana*, *Terminalia Oliverii*, *Capparis burmanica*, *Phyllanthus emblica*, *Zizyphus jujuba*, *Flacourtia Cataphracta*, *Carissa spinarum*, *Gardenia turgida*, *G. sessiliflora*, and *Limnium acidissima*.

12. **The Andamans.** The forests of the Andamans resemble those of Burma in general features. The climate of the Andamans is warm and equable. The rainfall at Port Blair is 118 inches but by the aspect of the forests it is probably somewhat less in the North Andamans. The main type of forests are: (a) Mangrove Forests, (b) Beach Forests, (c) Evergreen Forests, (d) Semi-evergreen and deciduous Forests, and (e) Diluvial forests.

CHAPTER XX

FLORA OF ADEN.

Menispermaceae.	<i>Cocculus laevis</i> , D. C.
	<i>C. sp.</i>
Cruciferae.	<i>Farsetia longisiliqua</i> , Dene.
	<i>Diplotaxis pendula</i> , D. C.
Capparidaceae.	<i>Cleome quinquerivaria</i> , D. C.
	<i>C. pappilosa</i> , Steud.

	<i>C. brachycarpa.</i>
	<i>C. paradoxa</i> , R. Br.
	<i>C. pruinosa</i> , Anders.
	<i>C. brachystyla</i> , Deff.
	<i>C. polytricha</i> , Franch.
	<i>Dipterygium glaucum</i> , Dene.
	<i>Maerua thomsoni</i> , Andrs.
	<i>M. crassifolia</i> , Forsk.
	<i>M. ovalifolia</i> , Cambess.
	<i>Cadaba rotundifolia</i> , Forks.
	<i>C. glandulosa</i> , Forks.
	<i>C. longifolia</i> , D.C.
	<i>C. farinosa</i> , Forks.
	<i>Capparis galeata</i> , Fresen.
	<i>C. decidua</i> , Forsk.
Resedaceae.	<i>Reseda amblyocarpa</i> , Fresen.
Polygalaceae.	<i>Polygala erioptera</i> , D. C.
	<i>P. thurmaniana</i> .
Caryophyllaceae.	<i>Polycarpaea corymbosa</i> , Lam.
	<i>P. spicata</i> , Wight.
	<i>P. fragilis</i> , Del.
	<i>Sphaerocoma Hookeri</i> , Anders.
	<i>Gypsophylla montana</i> .
	<i>Cometes abyssinica</i> , R. Br.
Portulacaceae.	<i>Portulaca quadrifida</i> , L.D.C.
Malvaceae	<i>Abutilon fruticosum</i> , Guill.
	<i>Hibiscus micranthus</i> , L. Mant.
	<i>H. welshii</i> , Anders.
Sterculiaceae.	<i>Sterculia arabica</i> , Anders.
	<i>Melhania denhamii</i> , R. Br.
Tiliaceae.	<i>Grewia populifolia</i> , Vahl.
	<i>Çorchorus antichorus</i> , Raeuschel.
	<i>C. trilocularis</i> , L. Mant.

Zygophyllaceae.	C. olitorius, L. Sp. Tribulus terrestris, L. Sp. Zygophyllum simplex, L. Mant. Fagonia cretica, L. Sp. F. parviflora, Bois. F. glabra, Kraus.
Burseraceae.	Balsamodendron opobalsamum, Kth.
Rhamnaceae.	Zizyphus spina Christi, Willd. Z. lotus, Lam.
Vitaceae.	Vitis quadrangularis, Wall.
Moringaceae.	Moringa aptera, Gaertn.
Leguminosae.	Crotalaria lupinoides, Hochst. C. leptocarpa, Balf. C. schweinfurthii, Deff. Argerolobium arabicum, Jaub. A. roseum, Jaub. Indigofera apucifolia, Del. I. parvula, Del. I. semitrijuga, Forsk. I. arabica, Jaub. I. argentea, L. Mant. Tephrosia apollinea, Link. T. pogonostigma, Bois. Taverneira glauca, Edgew. Alhagi mourorum, Desv. Rhynchosia minima, D.C. Poinciana elata, L. Mant. Cassia obovata, Collad. C. holosericea, Fresen. C. angustifolia, Vahl. C. adensis, Benth. Acasia eburnea, Willd. A. edgeworthii, Anders.

Combretaceae.

Loasaceae.

Cucurbitaceae.

Ficoidae.

Umbeiliferaee.

Rubiaceae.

Compositae.

Salvadoraceae.

Apocynaceae.

Asclepiadaceae.

A. hamulosa, Benth.

A. spirocarpa, Hochst.

A. nubica, Benth.

A. arabica, Willd.

A. mellefera A. Rich.

Terminalia Sp.

Kissenia spathulata, R. Br.

Cucumis Prophetarum, L. Cent.

C. pustulatus, Hook.

Corralocarpus velutinus, Benth and
Hook.

C. glomeruliflorus, Schweinf.

Citrus colocynthus, Schrad.

Trianthema crystallina, Vahl.

T. pentandra, L. Mant.

Orygia decumbens, Forsk.

Mollugo cerviana.

Limeum indicum, Stocks.

Ptychotis arabica, Anders.

Oldendia Sp.

Oldenlandia shimperii, Anders.

Vernonia atriplicifolia, Jaub.

Iphiona scabra, Dene.

Pulicaria glutinosa, Jaub.

Dicoma schimperii, O. Haoffman.

Launea lactucoides, O. Hoffman.

L. nudicaulis, Less.

Lactuca gorsuansis, Schultz.

Salvadora persica, L. Sp.

S. oleoides, Dene.

Adenium obesum, Roem.

A. arabicum, Balf.

Glossonema boveanum, Dene.

- Boraginaceae. *Calotropis procera*, R. Br.
Steinheilila radians, Dene.
Caralluma forskalii, K. Schum.
C. adensis, K. Schum.
Echiochilon fruticosum, Desf.
Heliotropium strigosum, Willd.
H. zeylanicum, Lam.
Heliotropium pterocarpum, Hoch. st.
H. ophioglossum, Stocks.
H. lignosum, Vatke.
H. adensis, Guerke.
Arnebia hispidissima, D.C.
 Convolvulaceae. *Convolvulus glomeratus*, Chois.
C. sericophyllus, Anders.
Ipomea biloba, Forks.
Breweria latifolia, Benth.
 Solanaceae. *Lycium europium*, L. Syst.
 Scrophulariaceae. *Linaria mycilentia*, Dene.
Schweinfurthia tetrasperma,
 A. Braun.
Anticharis glandulosa, Aschers.
Lindenbergia sinaica, Benth.
Campylanthus junceus, Edgew.
 Acanthaceae. *Ruellia patula*, Jacq.
Blepharis edulis, Pers.
 Verbenaceae. *Bauchia maribifolia*, Schaur.
B. pterigocarpa, Schaur.
 Labiatae. *Ocimum grattissimum*, L. var *suave*,
 J.D. Hook.
Lavandula setifera, Anders.
Orthosiphon pallidus, Royl.
 Nyctaginaceae. *Boerhaavia verticillata*, Poir.
B. elegans, Chois.

Amarantaceae.

Chenopodiaceae.

Aristolochiaceae.

Euphorbiaceae.

Urticaceae.

Gnetaceae.

Ammarillidaceae.

Liliaceae.

Commelinaceae.

Niadaceae.

Cyperaceae.

Aerua javanica, Juss.

Saltia papposa, Mog.

Sueda monoica, Forsk.

S. vermiculata, Forks.

S. fruticosa, Forks.

Traganum nudatum.

Halopeplis perfoliata, Bunge.

Salsola bottae.

S. forskalli, Schweinf.

Anabasis ehrenbergii, Schweinf.

Aristolochia brachiata, Obs.

Phyllanthus madarraspatensis, L. Sp.

Jatropha spinosa, Vahl.

Chrozophora obliqua, A. Juss.

Euphorbia arabica, Hochst.

E. cuneata, Vahl.

E. schimperii, Pres.

E. systyla Edgew.

E. granulata, Forsk.

E. adensis, Deffl.

E. polycnemoides, Hochst.

Forskohlea tenacissima, L. Mant.

F. viridis, Ehrbg.

Ephedra foliata, Staf.

Var *ciliata*, Aith.

Pancratium tortuosum, Herb.

P. maximum, Forsk.

Albuca yerburyi, Ridley.

Commelina albescence, Hassk.

Cymodocea ciliata, Ehrbg.

C. serrulata, Aschers.

Cyperus conglomeratus, Rthh.

C. effusus, Rothh.

Graminae.

C. falcatus, Nees.
Paspalum pinnatum, Hook.
Panicum colonum, L. Syst.
P. turgidum, Forsk.
Tricholiana tenneriffe, Parl.
T. leucantha, Hochst.
Setaria verticillata, Beauv.
S. viridis, Beauv.
Pennisetum ciliare, Link.
Andropogon foveolatus, Del.
Aristida adscensionis, L. Sp.
A. plumosa, Linn.
A. caloptila, Bois.
A. hirtigluma, Steud.
Sporobolus glaucifolius, Hochst.
S. spicatus, Kunth.
S. sp.
Pycnodon dactylon, Pers.
Pappophorum ciliaris, Link.
 var brachystachyu M. Bois.
Eragrostes sinosuriodes, Beauv.
E. major, Hoist.
E. mucronata.
Aeluropus villosus, Trin.
A. littoralis.
Tetrapogon villosus, Desf.
Eleusineegyptiaca, Desf.

Climate:—The climate of Aden during the North-East Monsoon (October to April) is cool, and in the months of November, December and January pleasant and agreeable. During the rest of the year, hot sandy winds known as "Shamal" or North prevail within the crater. On the Western side, however, or Steamer point, the breezes coming off the sea

are cool and refreshing. Average minimum temperature is 84° and maximum 82°. The rainfall registered at the Civil Hospital in the Crater is 8 inches in the year of which four falls in March and one in April.

The flora of Aden is very poor. We give a list of 196 plants, which are representatives of 47 orders and 114 genera. The proportion of Natural Orders and, genera and species is 1:2.42; 4.17. On the neighbouring Socotra, an island in the Indian Ocean, the vegetation shows the following proportions according to Kraus. 1;4;7. This seems to indicate that the paucity of species in the flora of Aden is not the result of situation or isolation but the necessary consequence of the meteorological factors combined with unfavourable edaphic conditions. Of the 196 species 35 are Monocotyledons, chiefly represented by the Graminae and 160 Dicotyledons, which owe the high number specially to the Leguminous species with 28 species and to the Capparidaceae with 17 species.

The rain is very scanty and the falls are of short duration. After a short time the rain-water evaporates or sinks into the lower layers of the soil.

The following plants have their leaves reduced in size, and sometimes also in number:—

Farsetia longisiliqua.

Cocculus loeba.

Dipterigium glaucum.

Cleome pappilosa.

C. brachicarpa.

C. paradoxa.

Maerua thomsonii.

Cadaba glandulosa.

Polygala erioptera.

Polycarpea corymbosa.

I. paucifolia.

I. parvula.

Taverneiria glauca.

Rhynchosia minima var. *memnonia*.

Oldenlandia schimperi.

Heliotropium strigosum.

Convolvulus glomeratus.

Linaria macilenta.

Schweinfurthia pterosperma.

Spherocoma Hookerii.
 Corchorus antichorus.
 Grewia populifolia.
 Zygodphyllum simplex.
 Balsamodendron opobalsamum.
 Moringa aptera.
 Indigofera semitrijuga.
 Indigofera arbica.

Campylanthus juncea.
 Lavandula setifera.
 Saltia papposa.
 Sueda fruticosa.
 S. vermiculata.
 Euphorbia arabica.
 E. cuneata.
 E. systyla.
 Ephedra foliata var ciliata.

The aridity of the climate also favours the production of spines and spinous structures. The following only need be mentioned.

Capparis galeata, Fagonia cretica, Zizyphus lotus, Z. spina Christi, Sphaerocoma hookerii, Acasia Edgeworthi, A. eburnea, A. hamulosa, A. spirocarpa, A. nubia, Lycium europium, Blepharis edulis, Jatropha spinosa. Alhagi mourorum.

CHAPTER XXI

SOME WILD FODDER PLANTS OF THE BOMBAY PRESIDENCY

Graminaceae.	Andropogon annulatus.
	„ Monticola.
	„ triticeus.
	„ contortus.
	„ pumilus.
	„ pertusus.
	„ Lawsonii.
	„ purpurio-sericeus.
	„ halepensis.

Ischemum pilosum.
 „ *sulcatum.*
Iseilema Wightii.
 „ *anthophoroides.*
Panicum Isachne?
Chloris barbata.
 „ *virgata.*
Paspalum sanguinale var. *ciliare!*
Dinebra arabica.
Pennesetum cenchroides.
Cenchrus biflorus.
Apluda varia.
Thelepogon elegans.
Eleusine aegyptiaca.
Anthistiria ciliata.
Indigoora glandulosa.
 „ *trifoliata.*
 „ *linifolia.*
Alisicarpus pubescens.
 „ *rugosus.*
 „ *longifolius.*
Psoralia corylifolia.
Sesbania aculeata.
Heylandia latebrosa.
Tephrosia pupurea.

Leguminosae.
 (Papilionaceae.)

CHAPTER XXII

THE CHARACTER AND DISTRIBUTION OF FORESTS IN INDIA

The distribution of the tree-growth and of the chief types of forest in India, as also the size of the individual trees, varies

in direct proportion to the amount of rainfall experienced in the different parts of the country. Rainfall is not, however, the sole factor regulating this distribution and change in type. Elevation also produces marked changes. In a country where a very great variety of climate exists, from the Sub-Arctic or Alpine to the Tropic, sharp changes will of necessity make their appearance in different regions. Aspect also has a considerable influence on the character of the Forests, accompanied as it may be, by either sharp frosts or scorching winds. The overflow of the large rivers and percolation are responsible for a considerable variety in the type of the forest present in large tracts of the country. In areas where the rainfall is scanty, or almost wanting, as in the deserts of Rajputana, for instance, tree growth is absent, whilst in other regions the character of the forests is decided by their position on the sea-board or in the deltas of the great rivers, where the Mangrove forests reign supreme. Further it becomes necessary to give some brief description of the great differences in the main types of forest growth in the country.

India may be divided into four climatic zones which exert a marked influence in the distribution of the forest types.

I. **The Dry Zone.**—An average rainfall of from 15 to 30 inches. This zone comprises the large oval plateau-like tract in which the Kistna, Godavery and Cauvery have their sources. It extends from Nasik in the Bombay Presidency south-eastwards to below Bangalore, with an average breadth of 200 to 250 miles.

II. **The Intermediate Zone.**—An average rainfall of between 30 to 50 inches. This consists of a narrow strip situated to the West of the dry zone, but includes the whole of the tracts to the North, north-east and east of the latter as far as the Bay of Bengal.

III. **The Moist Zone.**—An average rainfall of 50 to 75 inches. This forms a narrow belt to the west of the Intermediate Zone along the eastern slopes of the Western Ghats, and embracing also the seaboard of the southern portion of the Gulf of Cambay and the northern part of Travancore.

IV. **The Wet Zone.**—An average rainfall of over 75 inches. This zone includes the remaining portion of the Ghats lying to the Westward, consisting of the Western slopes with which the moisture-laden south-west monsoon currents first come into contact on their passage north-eastwards.

Curiously enough, differences in latitude exert comparatively small changes in the forest flora. There are no such abrupt changes as exist in Europe, where the Alps sharply divide the northern and southern forest floras. A study of the Indian flora discloses the fact that certain species are characteristic of the southern part of the country, as for example, the TEAK and *Xylia dolabriformis*, whereas others are representative of the north; but there are many others which occur throughout the length and breadth of the Empire. That no sharp changes or marked contrasts exist in the flora is attributed to the fact, which is equally true of the fauna, that the great Indian continent is completely isolated on the north by the great wall of the Himalayas and surrounded on the other sides by the sea.

References:—Ribbentrop: Forestry in British India.

Brandis: Paper read before the Geographical Section of the British Association at Brighton in 1872.

Gamble: Manual of Indian Timbers.

Brandis: Indian Trees.

Prof. R. S. Hole: Sylviculture of Indian Trees.

In the last book Professor Troup divided the types of forest in India and Burma, including the Andamans, into 12 regions. They are as follow:—

1. The West Himalayan.
2. The East Himalayan.
3. The Trans-Indus.
4. The North-Western Region.
5. The Gangetic Plane.
6. The West Coast Region.
7. The Central Indian.
8. The Deccan and Carnatic.
9. Assam.
10. Chittagong and Arakan.
11. Burma.
12. The Anadamans.

Distribution of forests in India.

From the Forester's point of view, India may be divided into seven zones, containing fairly distinct types of growth.

- | | |
|----------------------------|----------------------------------|
| (A) Evergreen Forest Zone. | { Dependent on or due to |
| (B) Deciduous Forest Zone. | { rainfall. |
| (C) Dry Forest Zone. | { Due to paucity of rainfall. |
| (D) Alpine Forest Zone. | { Due to elevation. |
| (E) Riparian Forest Zone. | { Lands subject to overflow or |
| | { percolation from rivers. |
| (F) Tidal Forest Zone. | { Subject to tidal influences. |
| (G) Zones without Forest. | { Due to absence of rain, exces- |
| | { sive enundation or elevation. |

The Evergreen Zone may be divided into four distinct geographical regions :—

(1) The West Coast Region.

(2) **The Burma and Chitagong Region.** (Including the Andamans.)

(3) **The Carantak Region.**

(4) **The sub or outer Himalayan Region.**

The growth of the Karantak region is influenced by the North-East Monsoon, that of the other three by the South-West Monsoon.

(B) The Deciduous Forest Zone. For Forestry purposes this zone may be divided into two chief zones.

(1) The Central India Deciduous Region.

(2) The Burma Deciduous Region.

(C) The Dry Forest Zone. The dry forest zone occupies two separate regions.

(1) The Rajputana Region.

(2) The Punjab Region.

(D) The Alpine Forest Zone. Forests of this zone may be divided into four chief regions according to their positions on the North West or North Eastern parts of India. The Region consists of the Alpine Forests of

(1) The Western Himalayan Region.

(2) The Afganistan and Baluchistan Region.

(3) The Eastern Himalayan.

(4) The Burma Region.

(E) The Reparian Forest Zone.

(1) The Forests of Lower Indus in the Sind Desert.

(2) The Swamp Forests of Burma.

(F) The Tidal Forests Zone. Comprise Forests situated in the alluvial land on the sea coast and its neighbourhood and those growing on the deltas of larger rivers, up this bank as far as the tide flows.

(G) **Zones without Forests.** Mountains above the line of Vegetation of tree-level, rocky areas devoid of soil and truly desert regions which comprise plains, plateau and hills.

A. The Evergreen Forest Zone. The Exergreen Zone may be sub-divided into four distinct geographical regions:—

- (1) The West Coast Region.
- (2) The Burma and Chittagong Region (Including the Andamans.)
- (3) The Karantic Region and
- (4) The Sub or Outer Himalayan Region. The growth in the Karantic Region is influenced by the North East Monsoon, that of the other three by the South West Monsoon.

(1) The West Coast Region:—This region covers the coast districts of the Konkan, Canara, Malabar, and Travancore, and extends over the Western scarps of the mountainous ranges behind them in the Mahrata Country, Coorg, the Nilgiris, Anaimalais, Cochin, and the Travancore Hills. The trees occupying the forests of this region may belong to the Anonaceae, Guttiferae, Diperocarpaceae, Anacardiaceae, Myrtaceae, Rubiaceae, Lauraceae and Euphorbiaceae.

In parts of this region dry areas exist with a growth not unlike that of the deciduous forest of Central India and with a good deal of Teak. The greater part, however, consists of hill forests, the lower hill slopes being covered with evergreen forest growth of large trees such as :—

Dalbergia latifolia.
Xylia,
Artocarpus,
Pterocarpus,
Lagerstroemia,
Terminalia,

Vateria,
Canarium,
Cullenia,
Polyalthia,
Mesua.

Higher up, and especially in the hill ranges of the Nilgiris, Anaimalais, Pulneys and Travancore mountains, these ever green forests merge into what are known as the "Sholas" the principal vegetation consisting of *Eugenia*, *Michelia*, *Ilex*, *Hydnocarpus*, *Eleocarpus*, *Ternstroemia*, *Goedonia*, *Symplocos*, *Rhododendrons*, and laurels, with an undergrowth of *Strobilanthus*, and tree-ferns, etc. In this region teak is the chief tree of export, followed by blackwood (*Dalbergia latifolia*). In the hill ranges, plantations of exotic trees have been formed, pines, cypress etc., all of local importance for the provision of fuel. In the coast tract the Talipot palm is conspicuous, and in the Ghat region are found *Bentinckia* and *Arenga Wightii*, with many canes and bamboos, such as *Teinostachyum Wightii*, *Oxytenanthera Thwaitesii*, and species of *Ochlandra* and *Arundinaria Wightiana* on the higher hills.

(2) The Burmese Region. This region covers the coast and the western mountain slopes of the Mergui, Tavoy, Amherst, Kyaukpyu and Arakan districts, broadening and contracting according to the formation of the mountain chains, and spreading into favourably situated moist side-valleys of the Tennesserim, Salween, Sittang, Irrawady and Attaran rivers. The region extends into Bengal, and occupies considerable areas in the coast districts of Chittagong.

The variety of trees in this forests is very great, and the constituents of the forests vary considerably even in contiguous tracts. The height of the trees forming the upper canopy ranges from 150 to 200 feet, the tallest being such species as *Dipterocarpus turbinatus* and *alatus*; *Sterculia spicigera*, *foetida* and *complanata*; *Tetrameles nudiflora*, *Parkia leiophylla*, *Acrocarpus fraxinifolius*, *Albizzia Lebbeck* and *stipulata*; *Xylia dolabriformis*, and a few other species.

The above are leaf-shedding trees which tower above the mass of evergreens. Of less lofty trees the variety is considerable, and include such species as *Mesua ferrea*, *Mitrephora vandaeflora*, *Bursera serrata*, *Kurrimia robusta*, *Steriospermum fimbriatum*, *Vitex peduncularis*, *Adenanthera pavonia*, *Cedrela Toona*, *Lagerstroemia calyculata*, *villosa* and *tomentosa*; *Mangifera indica*, *Trewia nudiflora*; these species being associated with a large number of others. Of those which form a lower storey under the shade of the loftier trees, a few may be mentioned, such as *Pterospermum*, *Garcinia*, *Xanthochymus*, *Cinnamomum*, *Tetranthera*, etc.

As a rule, tropical evergreen forests which grow on metamorphic rocks are richest in species, while those occurring on the sand-stones and other sedimentary less-altered rocks are poorest in this respect.

The shrubby vegetation of these forests is densest along water courses, in places which have been cleared of the taller trees, and along the outskirts of the forests, almost disappearing in the dark interior.

Climbing Palms are numerous, such as *Nectocomiopsis paradoxus*, *Calamus latifolius*, and *longisetus*, Bamboos such as *Dinochloa M'Clellandii*, *Gigantochloa macrostachya*, *Dendrocalamus longispathus* and *Brandisii*, *Bambusa polymorpha*, are also numerous. Several species of these Bamboos frequently attain a height of ninety to hundred feet. Palms and screw-pines are found dispersed throughout these forests.

(3) **The Carnatic Region.** This is a different class of Forest from the one above described. When in good condition, it presents a dense thicket of close-grown trees, few of any great size, but most of them giving hard valuable woods. More often, owing to careless cutting, it is reduced to a condition of

thorny scrub. The area in which this class of forest is found begins at the Mahanadi and goes down almost the whole length of the Eastern coast, the best forest being probably those of Nellore, Cuddapah, and North Arcot. Chief among the trees of this forest are *Mimusops hexandra*, *Diospyros*, *Ebenum*, *Pterospermum*, *Eugenia*, *Memecylon*, *Pleurostylya*; while some few deciduous trees, like *Clhoroxylon Sweitenia* and *Soymeda febrifuga*, occasionally occur. When in bad condition, thorny shrubs such as *Randia*, *Canthium*, *Dichrostachys* and *Zizyphus*, are prominent; but when in good order, these forests are valuable sources of fuel and give some of the hardest woods of the country.

(4) **Sub-Himalayan Region.** This region covers the belt of low country bordering on the spurs of the eastern Sub-Himalayan range, entering deep into their valleys and covering the slopes of the lower spurs.

The number of species composing the forest is very great and the trees individually attain a great size, of which the more important are the following: *Schima Wallichii*, *Terminalia tomentosa* and *myriocarpa*; *Artocarpus Chaplasha*; *Cinnamomum glanduliferum*, *Echinocarpus sterculiaceus*, *Bombax malabaricum*, *Dillinia indica*, *Eugenia formosa* and *Pterospermum acerifolium*. On the lower hills occurs a *Magnolia*, also *Michelia Chamapaca* and *Duabanga sonneratioides*. At still higher elevations are found *Castanopsis indica*, *Alnus nepalensis* and *Bucklandia populnea*. This region runs into the Alpine Forest Zone (3) described later on.

The ground in these forests is usually covered with a dense growth of Ferns, climbers and inferior shrubs, which together form a tangled mass, rendering it extremely difficult to penetrate the interior. In the hilly portions a dense growth of Bamboo (*Dendrocalamus*) occurs, while the valleys are filled

with Screw-pines and Palms. Of the latter such species as *Wallichia disticha*, *Caryota urens*, *Areca gracilis* and *Phoenix rupicola* are conspicuous.

B. The Deciduous Forest Zone. For Forestry purposes this zone may be divided into two chief regions; (1) The Central India Deciduous Region and (2) The Burma Deciduous Region.

(1) The Central India Deciduous Region. This region includes what is practically the type-forest of India. It extends from the southern slopes of the Punjab Himalayas eastwards up the valley of Assam and southwards almost to Cape Comorin. It varies both in character and species in different parts of the great extent of the country it covers, but its general characteristic and growth remains the same. Some species occur in it almost universally, such as *Terminalia tomentosa*. *Arjuna* (along streams) *belerica*, and *Chebula*; *Lagerstroemia parviflora* *Butea frondosa* and *Bombax*. Others are found in more or less local areas *Anogeissus* does not extend to Northern Bengal; *Pterocarpus marsupium* and *Bassia latifolia* scarcely cross the Ganges northwards; while *Dillinia* and *Careya* are rare south of the Kistna. This deciduous forest type covers the plains country of the North Western Provinces, the Terai, the Duars and the Chota Nagpur, the hill tracts of Orissa and the Circars, the Central Provinces, Behar, Guzerat and Central India, Hyderabad and the East Mahratta country, the Nellary, Cuddapah and Mysore Hills, the hills of Coimbatore and Salem, the eastern slopes of the Nilgiris, Palnis (Pulneys) and parts of those of Tinnevely, especially on slopes with a southern aspect. It contains several sub-regions characterised by their principal trees. These consist of (a) the region of *Sal* (*Shorea robusta*), which follows the foot of the Himalayas from the Sutlej to the Borelli, and extends southwards nearly

to the Godavery in the Circars and to Nagpur in the Central Provinces; (b) the region of Ironwood (*Xylia dolabriformis*) in the forests of the Circars from the Mahanadi to the Kistna, extending westward into the Chanda district and Hyderabad; (c) the region of Teak (*Tectona grandis*), which commences where the Sal leaves off and extends southwards to the end, embracing in its general area (d) the region of Red Sanders (*Pterocarpus santalinum*) on the hills of Cudappah and North Arcot, and (e) the region of Sandal (*Santalum album*) on the hill ranges of Bellary, Coimbatore and Salem and the northern slopes of the Nilgiris.

The Sal is the chief species of sub-region (a). It occupies two principal tracts in India. Gamble thus describes these tracts: "The first is a belt at the foot of the Himalayas and running into its valleys and up its lower hills to 3,000 feet, and exceptionally, as for instance at Lansdown, to a still higher altitude. According to J. E. T. Aitchinson (*Flora of Hoshiarpur*") Journ Linn Soc. 1868) the Purvian Range is the western limit. Brandis says it occurs in patches on the Bias. It is found in the Kangra Valley, and the regular continuous forest commences in the Umbala Siwaliks, west of the Jumna, whence it passes through Dehra Dun, Saharanpur, Bijnor, Kumaon, Oudh, Gorakhpur, Nepal, the Darjeeling Terai, W. and E. Duars and up the Assam Valley, with an outer-lier in the Garo Hills. The second is the Central Indian belt, and the Sal country begins on the Ganges near Rajmahal and passes through the Sonthal Parganas, Rewah, Chota Nagpur, The Central Provinces, Orissa and the Northern Circars, ending in the Palkonda range of Vizagapatam and the forests of Jeypur.

The most uniformly gregarious among the timber trees of India, the Sal, in the forests in which it occurs, is always the prevailing tree, greater in number of individuals than all the rest put together. Brandis Jour. Linn Soc, 6) says regarding

it: "In a climate and on soil which suit it, it reigns supreme. The most suitable soil is either sandstone as in many parts of Central India, or alternating beds of shingle and sand, such as are found at the foot of the Himalayas or loam resting on gravel and sand."

For *Xylia dolabriformis* in the sub-region (b) Gamble gives the distribution as follows:—Eastern and Western Ghats of South India in deciduous forest, extending North to Orissa and Bombay, but not beyond Chanda in the Central Provinces, often more or less gregarious as in South Canara and Malabar and the Upper Godavery". Next to teak this tree is one of the principal trees of the Burma deciduous region.

The sub-region (c) forms the Western or Indian tract occupied by the teak (*Tectona grandis*), which is practically the whole of peninsula of India, the eastern tract being the Burmese.

Chief among trees characteristic of these forests are the *Terminalias*, *Lagerstroemia parviflora*, *Anoguissus latifolia*, *Dillinia indica*, *Eugenia jambolana*, and *Dalbargioides*, *Soymeda febrifuga*, *Chloroxylon Sweitenia*, *Pterocarpus marsupium*, *Diospyros melanoxylon*, *Bassia latifolia*, *Dalbergias*, *Albizzias*, *Bombax*, *Wrightia*, *Garuga*, *Bursera*, *Holarrhulina*, and there are many others, while the small male Bamboo (*Dendrocalamus strictus*) is almost universally characteristic. In this same region occur also the Sissoo (*Dalbergia sissoo*) gregarious along streams in the region between the Himalayas and the Ganges, and the *Acacia Catechu*, the Khair or Kutch tree, which with other species of *Acacia*, such as *suma*, and *leucophlea*, is everywhere indicative of somewhat poor sandy soil. Forming part of this same region too, is the great Regada or "Black Cotton Country" where *Acacia arabica* is the common tree, coming up wherever the land is fallow for a while, and

accompanied sometimes by *Albizzia Lebbek*, *Melia indica*, *Poinciana elata*, and *Balanites Roxburghii*.

(2) **The Burmese Deciduous Forests.** These are the typical forests of the drier parts of Burma, and are unquestionably the most important to the Foresters. They occupy that portion of the country, both in plains and Hills, in which the climate is drier and the rainfall is less. The most characteristic and important species of trees found in the Burma deciduous forests are the Teak, here attaining large dimensions, and *Xylia dolabriformis* (Pyngado). This forms the eastern tract of the teak. Associated with the above two trees are *Eugenia Jambolana*, *Bombax insignis*, *Sterculia versicolor*, *foetia* and *villosa*; *Pterospermum semisagittatum*, *Geruga pinnata*, *Bursera serrata*, *Semacarpus*, *Spondias mangifera*, *Terminalia*, *Anoguissus acuminata*, *Lagerstroemia Flos-regina*, *Bridelia retusa*, *Milletia Brandisiana*, *Cordia grandis*, *Gmelina arborea*, *Dalbergia Kurzii*, *Nauclea cordifolia*, *rotundifolia* and other species.

On the lower ground occur such species as *Vitex leucoxylon*, *Bombax malabaricum*, *Kydia calycina*, *Dolichandron stipulata*, *Heterophragma adenophyllum*; several *Albizzias*, such as *A. odoratissima*, and *procera*; *Acasia Catechu*, *Ficus*, *Randia*, *Gardenia*, *Bauhinia*, *Grewia*, *Schrebera swietenoides*, and others. The real Padauk tree of Burma (*Pterocarpus macrocarpus*) and *P. indicus*, though occasionally found in evergreen forests, are in their natural habitat in this class of forests in Burma, as is also the case with *P. dalbergioides* in the Andamans. In the latter locality this tree attains very large dimensions. Herbage and shrubs, though not dense are more conspicuous than in the deciduous forests of Central India type. Bamboos prevail. Climbing shrubs are numerous in all the moister tracts *Butea superba*, *parviflora*, *Entada scandens*, several species of *Vitis* *Millettia auriculata*, *Mezoneurum cucu-*

latum being conspicuous. A few palms occur, but are much reduced in size.

The wood-oil bearing forests are composed of several species of Dipterocarps, principally *tuberculatus*. In these forests *Pentacme suavis*, *Dillenia pulcherima*, and *shorea robusta* form quite a feature.

C. **The Dry Forest Zone.** The dry forest zone occupies two separate regions (1) Rajputana, (2) The Punjab.

(1) **The Rajputana Region.** Owing to the limited rainfall the forest flora of Rajputana is not a rich one, nor are the trees much developed. The province is divided by the Aravalli range of Hills into two unequal parts—the part eastward of the range lying in the basin of the Chambal river, and that lying to the westward in the basin of the Indus. The country to the east of the range is more or less hilly, and has a climate and forest vegetation somewhat resembling those of Central India and the drier parts of the United Provinces. Where not actually hilly, the surface is undulating. To the westward of the central range the country is much flatter and drier, and as the Sind and Punjab frontiers are approached, it passes into actual desert.

The forests of Rajputana are in the main composed of the following species, none of them attaining full development. Among the largest of the trees may be mentioned *Bombax malabaricum*; among the smaller trees are *Prosopis specigera*, *Sterculia urens*, *Semecarpus anacardium*, *Acasia leucophloe* and *Catechu*; *Anoguissus latifolia* and *pendula*; *Dichrostachys cinera*, *Cordia Rothii* and *myxa*; *Phyllanthus emblica*, *Erythrina suberosa*, *Bauhinia variegata*, *Gmelina arborea*, *Boswellia thurifera*, *Butea frondosa*, *Terminalia tomentosa* and *Arjuna*. Climbing plants and shrubs are numerous; among the former are *Cocculus villosus* and *Leaeba*, *Celastrus paniculatus*, *Vitis*

latifolia; among the latter are: *Mimosa rubicaulis*, *Capparis aphylla*, *spinosa*, *horrida* and *sepieria*; *Zizyphus nummularia* and *zylopyrus*; several *Grewias* such as *G. populifolia*, *pilosa*, *villosa*, and *salvifolia*; *Celastrus senegalensis*, *Buchanania latifolia* and *Diospyros montana* are small trees.

As the western border of the province is approached the forest vegetation passes into desert forms, of which the following are important:—*Prosopis specigera*, *salvadora persica*, and *Acacia senegal*.

(2) **The Punjab Region.** The species of trees found in this region are still fewer, owing doubtless to the fact that the monsoon rains are still lighter than in Rajputana; and this is the case more especially in the southern part of the Province, which contains the dry forest region. The chief representative species are:—*Acacia arabica*, *modesta*, *leucophlea*, *Butea frondosa*, *Prosopis specigera*, *Tamarix articulata*, and *Salvadora persica*, *Dalbergia sissoo*, *Albizzia procera*, and others are found where the water is near the surface. These forests, become, towards the hills, richer in species and gradually blend with the deciduous forests and the forests characteristic of the Western Himalaya. On the other hand, they disappear in the deserts of Sind and Bahawalpur, where only the river banks are fringed with tree vegetation.

D. The Alpine Forest Zone. The forests of this zone may be divided into four chief regions, according to their position on the North-Western, Northern or North-Eastern frontier of India. These regions consist of the Alpine forests of

- (1) The Western Himalayas.
- (2) Afghanistan and Baluchistan.
- (3) The Eastern Himalaya.
- (4) Burma.

(1) **The Alpine Forests of Western Himalayan Region:—**
This region extends from the outer hills, where the forest is

characteristic of the deciduous forest zone up into the great mountains of the Himalayan chains, rising far above tree-level to over 24,000 feet and the regions of perpetual snow. In this great mountain mass deep gorges and valleys of varying width, length and elevation occur, the physical features in consequence being extraordinarily varied. On the outer hills and ranges the Monsoon rainfall is heavy, but only occurs for a few months; consequently the flora does not obtain the same benefit from it as would be the case if it were more uniformly distributed. The monsoon rainfall decreases in amount as it penetrates into the interior, each successive barrier they strike upon relieving the rain clouds of a part of their moisture, until beyond the snow-line all that is left of the monsoon rains is represented by a short period of misty weather. The area over which this heavy rainfall is distributed also varies, being broadest as it proceeds eastwards and decreasing westwards where it does not extend beyond Dalhousie. As would be expected the vegetation, and especially the herbaceous portion, changes with the climate and degree of moisture, being luxuriant in Nepal and disappearing to a great extent on the arid Afghan Hills. The tree-growth also presents some marked changes. Of the former, Zingiberaceae, Orchidaceae, Aroidae and Begoniaceae are very characteristic of the vegetation of the Himalayas. They occur in small numbers in Kumaon, diminishing to the westward, and are scarcely to be found beyond the Sutlej, the climate here being too dry for them. The converse is to be found in the genus *Artimisia*, which is abundant in the Western Himalayas, whereas only two out of the twenty-five Indian species occur in the Eastern Mountains.

Trees and shrub growth present changes with the decrease of moisture from the outer to the inner Himalayas, *Quercus incana* and *Rhododendron arboreum* being characteristic of the outer and *Pinus Gerardina* (which commences to appear

on the north side of the Wangti river on the Hindustan-Tibet Road, for instance) and Ephedra of the inner mountains; west of the Ravi the change from the outer flora type to that of the inner is more rapid owing to the lesser rainfall, the *Quercus incana* etc. being only found on the outermost range. In the more elevated temperate areas trees and shrubs of European genera and species occur, such as Yew, Juniper, Walnut, Box, Ivy and Mistletoe. Four Conifers are particularly characteristic of the region, viz. Deodar (*Cedrus deodara*) Pinus Gerardina, the Cypress, (*C. tortuosa*) and Juniper (*Juniperus Communis*). These only extend eastward for short distance into Nepal and the Eastern Himalaya. The Deodar does not extend eastward of the West of Nepal; its habitat is from 4,000 feet (in the Punjab) up to 10,000 feet, and it is found even higher. In the Kumoun its minimum elevation is about 7,000 feet.

The Sal is the principal species of this forest. Others are: *Terminalia tomentosa*, and *Chebula*, *Adina cordifolia*, *Anogonissus latifolia*, *Ougenia dalbergioides*, *Dalbergia sissoo*, *Acacia Catechu*. *Pinus longifolia*, *Buchanania latifolia*, *Bauhinias*, *Ougenia dalbergioides*, *Boehmeria rugosula*, *Bauhinia retusa*, *Engellhardtia*, *Colebrookiana*, and sp. of *Ficus*. The commonest trees are *Quercus incana*, *Rhododendron arboreum* and *Peiris ovalifolia*, all of these occur throughout the Himalayas. In the valleys and ravines the forest is usually very different, containing such species as *Quercus glauca*, *Celtis*, *Alnus*, *Æsculus*, *Populus ciliata*, *Ulmus Wallichiana*, *Betula alnoides*, *Carpinus viminea*, several maples and others. Between six thousand and eight thousand feet is the chief zone of the Deodar and the Blue pine, as well as of the Cypress; while above 7,000 feet *Quercus dilatata*, Box (*Buxus sempervirens*) forests occur in damp valleys, especially on lime stone. Between 8,000 and 10,000 feet the principal trees are the Himalayan Spruce (*Picea morinda*), the Himalayan Silver Firs (*Abies*

webbiana and *A. Pindrow*), the former from 10 to 14,000 feet, the latter from 7 to 9,000 feet or altitude above, and a third Oak the Kharshu (*Quercus semicarpifolius*); while small Bamboos, with numerous *Strobilanthes* and Balsams are conspicuous features of the undergrowth. One of the last trees met with on ascending to 12,000 feet is Birch (*Betula utilis*), accompanied by a tangled undergrowth of straggling shrubby *Rhododendron* (*R. Anthopogon*). Above this again is the Juniper, whilst close to the snow-line all trees and shrubs have disappeared, their places being occupied by Alpine plants, such as Gentians, Primroses, with Mosses and other cryptogams.

(2) **The Alpine Forests of the Afghanistan and Baluchistan Region.** The characteristics of the Western Himalayan forests persist in this region as far south as the Kurram Valley. The conifers consist of the Deodar *Pinus Gerardiana*. The Blue Pine (*Pinus exelsa*) the spruce, Silver Fir and *Juniperus excelsa*; The Oaks are restricted to *Q. ilex* and *semicarpifolius*, occurring with *Prunus padus* and a species of *Rhus*. At the upper elevations the Birch is replaced by thickets of dwarfed *Juniperus communis*. The undergrowth consists of *Rhododendron campanulatum*, *Viburnum*, *Syringa Emodi* and *persica*, *Crataegus Oxycanthus*, *Cotoneaster baccularis*, wild roses and species of *Ribes* etc. South of the Kurram the forest becomes poorer in character filling the high side valleys, the outer hills becoming more and more barren until Baluchistan is reached. The chief trees of Baluchistan proper with tributaries of the Harnai and the Bolan are the *Juniperus macropoda*, which forms forests, and the olive, which is seen dotted over the barren hills. In favourable situations, clumps or isolated individuals of the following are found:—*Pistacia Khinjuk*, *Berberis*, *Fraxinus xanthoxyloides* and *Cratagus Oxycantha*. In North Zhoab the *Pinus Gerardiana* appears in small blocks of forest, as at Singhar, Spiraghar etc. In this region the tribesmen attach a

high value to the edible seed of this Pine which they collect and sell. ('Chilgoza').

(3) **The Alpine Forests of the Eastern Himalayan Region.** The higher forests of this region consist of the Conifers Silver Fir, *Abies Webbiana*, the Spruce, Larch (*Larix Griffithi*) which is only found in the inner ranges, *Juniperus recurvus* and the Hemlock Spruce (*Tsuga Brunoniana*).

Below the Conifers come the Rhododendrons which form gregarious forests. Commonest are *R. Dalhousia*, *Edgeworthii* and the species already mentioned. The Oaks and Chestnuts begin to appear at the lower elevations occupied by the Rhododendrons. Lower down *Magnolia Cambelli*, and others, *Michelia excelsa*, *lanuginosa* and *Cathartica* with large Maple, Laurels, and species of *Echinocarpus*, *Bucklandia*, *Eleocarpus*, *Phoebe* and *Nyssa* and several species of Bamboos, tree-Ferns and Canes are met with; also climbers such as *Thunbergia* and others, conspicuous owing to their bright-coloured flowers. Still lower the forest changes: large trees of *Cedrela*, *Terminalia*, *Daubanga*, *Canarium*, etc. make their appearance with palms of the genera *Caryota* *Iivivostonia*, *Phoenix*, *Didymosperma* and the large Screw-Pine *Pandanus furcatus*. This type drops down into the Sal Forest with its associated species, which is characteristic of the deciduous forest zone. The Tista and Rungeet Valleys exhibit the character of this zone as it appears in the foot-hills of the Eastern Himalayas a merveille, and shows the differences existing in the zone due to the heavier rainfall and damper heat of the eastern foot-hills.

(4) **The Alpine Forest of Burma Region.** The Burmese tropical evergreen forests give place at elevations of from 3,000 to 3,500 feet to trees more characteristic of temperate climates the development owing to the dampness being very great. Oaks, Chestnuts (*Castanopsis tribuloides*) with other Cupuli-

ferous species *Ternstroemia japonica*, *Bucklandia populnea*. Species of *Eugenia*, with temperate *Laurinae*, *Ostodes paniculata*, *Podocarpus* etc. Perhaps the most distinctive feature of the region are the Pines. At higher levels they form either pure or nearly pure forests, whilst lower down they are mixed with broad-leaved species such as *Eng.* The chief Pine is the *Pinus Khasya*, which occupies the hilly parts of Upper Ava and Martaban. In Upper Tenasserim a second Pine appears growing at a lower elevation, the *Pinus Merkusii*, occurring chiefly on the sandstone hills of the Thaungyin in Upper Tennaserim.

E. The Riparian Forest Zone. The types of forests found in this zone are almost invariably different from those of the surrounding forests, although they often present similar characteristics to the forests of the moister regions. The Riparian forests owe their special attributes to the water the areas they occupy receive from the periodical overflow of rivers, or to direct percolation from rivers or considerable sheets of inland waters. The forest vegetation resulting is usually different from that existing on adjacent areas beyond the reach of this overflow water. The individual areas occupied by this vegetation are not necessarily of great extent, but collectively they form a not inconsiderable part of the forest area of India. The character of this Riparian Forest varies according to its geographical position but two main types of this class of forest may be given as the characteristic of the zone: the first, the forests of the Lower Indus in the Sind desert, the second the Swamp forests of Burma.

The Riparian Forests in the rainless tracts of Sind are represented by mere fringes of tree vegetation on the river banks, where the rise of the Indus causes the inundation of large riparian areas during the hottest months. Large, valuable and quick-growing *Acacia Arabica* forests are the result of

these inundations, covering extensive areas of the low-lying alluvium. *Tamarix gallica* forests fringe the banks of all permanent rivers in the Sind-Punjab Zone, interspersed with *Populus euphratica*, *Dalbergia Sissoo* and *Acacia arabica* which even when no inundation takes place, are nourished by perennial percolation from the streams. These areas are in the North-West of India known as "Sailaba", and are easy of afforestation in spite of high grasses (*Saccharum Sara* and *Munja*) which frequently cover them.

The forest trees which are found to disappear as the banks of the stream are left, are the *Dalbergia Sissoo* and *Poplar*. *Acacia arabica* follows next and *Tamarix dioica* takes the place of the smaller *gallica*. Further on as the stratum of moisture is more remote from the surface, *Prosopis specigera*, *Salvadora persica* enters into the composition of the forest. *Capparis aphylla* soon after appears; gradually the forest gets more open the *Salvadora* and *Capparis* more bush-like, and when even the long roots of these desert trees cannot reach down to the water level, the last representatives of forest vegetation disappear on the borders of the desert.

The swamp forests of Burma are situated on the banks of the rivers, which at a considerable distance from the sea form the numerous branches, and especially during the rains are entirely free of brackishness, and they are also found on the shores of backwaters and lakes. The soil in these forests is more or less muddy throughout the greater part of the year; during the rains they are inundated, frequently to a considerable depth. The vegetation forms, as in the evergreen forests, three to four distinct strata; the upper canopy consists of trees such as *Anogonissus acuminata*, *Mangifera longipes*, *Xanthophyllum glaucum*, which, however, is only 70 to 80 feet high. The second stratum is formed by smaller trees and contains

several species of *Eugenia*, *Eleocarpus* and *Symplocos*. *Cassia fistula* and numerous other species of interest to the Botanist represent the third stratum. Amongst the shrubs are found *Grewia sinuata* a species of *Combretum* and of *Gardenia* and many others. The herbage is very scanty and of no special importance; but climbers are plentiful, and in places render the forest almost impenetrable. The most common species are *Jasminum scandens*, *Gmelina villosa*, *Acacia pinnata* etc.

F. The Tidal Forest Zone. The Tidal forest zone, as its designation implies, comprises the forests situated on the alluvial lands on the sea-coast and its neighbourhood and those growing on the deltas of the larger rivers and up their banks as far the tide flows. The species existing in these forests are dependent for their growth on the salt water reaching them. Along the sea face are the Mangrove Forests, consisting principally of *Rhizophoraceae* such as *Rhizophora mucronata* and *conjugata*; *Ceriops Roxburghiana*, *Kandelia Rheedii*, *Bruguiera parviflora*, *Sonneratia apetala*, *acida* and *Griffithii*; *Ægecerus majus* and *Carapa molluccensis* are also there.

Further inland, where the land is inundated only during the spring tides, the Mangrove forests pass into Tidal Forests, in which the abovenamed species become more subordinate; while *Sonneratia apetala* and *Avicennia officinalis* prevail, associated with *Hibiscus tiliaceus*, *Thespesia populnea*, *Heritiera littoralis* and *minor*; *Pongamia glabra*, *Excoecaria Agallocha*, *Phoenix paludosa* and several others less conspicuous trees. *Heritiera minor* (the Sundri tree of the Sunderbans) is the most common and most valuable tree in these forests. Shrubs, such as the following are much developed: *Acanthus ilicifolius*; *Clerodendron inerme* *Pluchea indica*, *Glochidion multiloculare* and *Ægialitia rotundifolia* mixed with climbers such as *Derris scandens*, *uliginosa* and *sinuata*, *Acanthus* and

others. *Nipa fruticans* and *Pandanus foetidus* locally form dense thickets.

G. Zone Without Forest. This zone is not characteristic of one particular region of India, but, from quite different causes, occurs in various parts of the country. It comprises the mountains above the line of vegetation or tree-level, rocky areas devoid of soil and thus incapable of carrying tree growth, areas subject to prolonged inundation and for that reason treeless, and the truly desert regions which comprise plains, plateaux and hills. The areas which are treeless on account of their elevation are situated in the Himalaya, but those which are barren on account of their declivity are distributed over all the mountain ranges of the empire. The tracts on which no forest grows on account of prolonged inundation are chiefly found in Assam, Bengal and Burma; they are covered with tall grasses, wild plantains and other herbaceous growth, here and there overshadowed by a tall Cotton (*Bombax*) tree. The desert areas of the Empire are chiefly confined to the drainage area of the Indus, south of the twenty-ninth degree; but even in these deserts the course of perennial rivers are, as already stated, fringed with tree-vegetation, and though the hills in these zones are barren, small trees and bushes are found in valleys and ravines and in the vicinity of springs.

It has been already mentioned that the boundaries of these zones of the forest growth of India are nowhere sharp and distinct. There is a gradual transition of one zone into the other; but not infrequently one zone is prolonged, with undisturbed characteristics, far into a neighbouring one of quite dissimilar character; or again, a disconnected area of a particular zone, definitely belonging to that zone, may be found quite outside the general limits of its own zone and surrounded by forest pertaining to a definite one. The shading off of one

zone into another is, of course, influenced by aspect and also by elevation. But the influence of aspect is not always constant, owing to the large area of the Continent and the great differences in climate. For instance, the scorching produced by the hot weather sun and dry blistering winds is inimical to tree growth, as also is a cold northern exposure. And to these must be added in varying degrees the physical qualities, the chemical composition of the soil and sub-soil and the distance below the surface of the permanent moisture.

Although, therefore, it is possible to broadly group the forests into the Zones and regions above delineated and to hold that these zones, for the purposes of the Forester, are sufficiently definite, it is not contemplated that such a treatment of the matter would fulfill strictly botanical requirements.

CHAPTER XXIII

VEGETATION OF THE KANKESHWAR TRACT

(Uncovered area 20%)

Temple Area.

First Stratum:

Dominants.

Mangifera indica.

Saraca indica.

Bauhinia Vahalii.

Ixora coccinea.

Carissa carandas.

Plumeria acutifolia.

Lantana camara.

Ficus Rumphii.

Second Stratum:

(a) Trees and tall shrubs.

Sterculia colorata.

Grewia microcos.

Gardenia lucida.

(b) Climbers.

Cocculus villosus.

Mucuna pruriens.

Symphorema involucratum.

Dioscorea pentaphylla.

Third Stratum:

Herbs and shrubs.
Ageratum conyzoides.
Cyathocline Iyrata.
Barleria Prionitis.
Blepharis asperima.
Daedalacanthus purpura-
scens.
Fleurya interrupta.

Herbaceous undergrowth of Monsoon:

Adiantum lunulatum.
Athyrium hohenackeria-
num.
Impatiens Kleinii.
Begonia crenata.
Elephantopus scaber.
Canscora diffusa.
Kyllinga triceps.

VEGETATION OF THE KAIVALYA-DHAM TRACT

(Uncovered area 10%)

First Stratum:

Dominants.
Mangifera indica.
Saraca indica.
Bauhinia Vahalii.
Anodendron paniculatum.

(b) Climbers.

Cocculus villosus.
Capparis sepiaria.
Vitis tomentosa.
Vitis trifolia.
Wagatea spicata.
Modecca palmata.
Hemidesmus indicus.
Leptadenia reticulata.
Argyreia speciosa.
Dioscorea pentaphylla.

Second Stratum:

(a) Trees and tall shrubs.
Pterospermum acerifolium.
Acacia concinna.
Terminalia chebula.
Terminalia bellerica.
Casearia graveolens.
Ixora coccinea.
Carissa carandas.
Holarrhena antidyse-
rica.
Lantana camara.
Ficus Rumphii.

Third Stratum:

Herbs and Shrubs.
Pavetta indica.
Ageratum conyzoides.
Cyathocline Iyrata.
Sesamum indicum.
Daedalacanthus roseus.
Daedalacanthus purpuras-
cens.

Haplanthus tentaculatus.
Strobilanthes perfoliatus.
Rungia repens.
Fleurya interrupta.
Herbaceous undergrowth of monsoon:

Adiantum lunulatum.
Athyrium hohenackerianum.
Begonia crenata.
Elephantopus scaber.
Kyllinga triceps.

VEGETATION OF THE WESTERN SLOPE

(Uncovered area 30%)

First Stratum:

Dominants.
Euphorbia ligularia.

Jasminum malabaricum.
Argyreia speciosa.

Second Stratum:

- (a) Trees and Tall Shrubs.
- Mangifera indica*.
 - Calycopteris floribunda*.
 - Memecylon umbellatum*.
 - Ficus retusa*.
 - Vitis Woodrowii*.
 - Grewia Microcos*.
 - Grewia tilifolia*.
 - Ixora coccinea*.
 - Carissa carandas*.
 - Lantana camara*.

(b) Climbers:

Tinospora cordifolia.
Capparis sepiaria.
Vitis tomentosa.
Vitis trifolia.
Mucuna pruriens.
Phaseolus Dalzellii.
Canavalia ensiformis.
Cansjera Rheedii.

Third Stratum:

Shrubs and herbs.
Pavetta indica.
Daedalacanthus purpurescens.
Barleria courtallica.
Haplanthus tentaculatus.
Ficus heterophylla.
Ocimum canum.
Rungia repens.
Martynia diandra.
Sesamum indicum.
Cyathocline lyrata.
Leea macrophylla.
Sida rhombifolia.
Sida acuta.
Emilia sonchifolia.
Bonnaya brachiata.

Herbaceous undergrowth of monsoon:

Biophytum sensitivum.
Alysicarpus vaginalis.

Geissaspis cristata.
Eclipta erecta.
Elephantopus scaber.
Evolvulus alsinoides.

Commelina benghalensis.
Commelina nudiflora.
Aeginetia indica.
 (Parasite).

VEGETATION OF THE NORTH-WESTERN SLOPE

(Uncovered Area 20%)

First Stratum:

Dominants.
Euphorbia ligularis.

Second Stratum:

(a) Trees and tall Shrubs.

Mangifera indica.
Erythrina stricta.
Pongamia glabra.
Albezzia stipulata.
Bombax insigne.
Ochrocarpos longifolius.
Ficus retusa.
Alseodaphne semicarpi-
folia.
Randia dumetorum.
Calycopteris floribunda.
Sterculia colorata.
Helicteris Isora.
Flacourtia latifolia.
Grewia microcos.
Grewia tilifolia.
Vitis Woodrowii.
Memecylon umbellatum.
Woodfordia floribunda.
Gardenia lucida.
Ixora coccinea.

(b) Climbers:

Mimosa hexandra.
Carissa carandas.
Ervatamia Heyneana.
Holarrhena antidysentrica.
Clematis hedysarifolia.
Tinospora cordifolia.
Vitis tomentosa.
Vitis trifolia.
Vitis repanda.
Pueraria tuberosa.
Phaseolus Dalzellii.
Modecca palmata.
Cansjera Rheedii.
Jasminum malabaricum.
Cryptolepis Buchanania.
Hemidesmus indicus.
Leptadenia reticulata.
Argyrea speciosa.
Symphorema involu-
tum.
Dioscorea pentaphylla.
Smilax macrophylla.

Third Stratum:

Shrubs and herbs.
Pavetta indica.

Martynia diandra.

Barleria courtallica.

Daedalacanthus roseus.

Daedalacanthus purpure-
cens.

Plectranthus incanus.

Clerodendron serratum.

Emilia sonchifolia.

Sida rhombifolia.

Sida acuta.

Rungia repens.

Herbaceous undergrowths of

Monsoon:

Biophytum sensitivum.

Evolvulus alsinoides.

Curculigo orchioides.

Chlorophytum tuberosum.

Aeginetia indica.

(Parasite).

VEGETATION OF THE DAND AREA

(Uncovered area 20%)

First Stratum:

Dominants.

Terminalia bellerica.

Terminalia chebula.

Gnetum scandens.

Alseodaphne semicarpi-
folia.

Bridelia stipularis.

Bridelia Hamiltonia.

Ficus infectoria.

Vitex negundo.

Lantana camara.

Carissa carandas.

Ixora coccinea.

Euphorbia ligularis.

Flacourtia latifolia.

Helicteris Isora.

Zizyphus Jujuba.

Zizyphus Oenoplia.

Zizyphus rugosa.

Vitis Woodrowii.

Hemigyrosa canadenses.

Calycopteris floribunda.

Leea macrophylla.

Ficus heterophylla.

Second Stratum:

(a) Trees and Tall Shrubs.

Dillenia pentagyna.

Ochrocarpos longifolius.

Sterculia gutata.

Pterospermum acerifolium.

Garuga pinnata.

Butea frondosa.

Erythrina stricta.

Pongamia glabra.

Albizzia stipulata.

Anogeissus latifolia.

Terminalia Catappa.

Eugenia jambolana.

- | | |
|------------------------------|--------------------------------|
| (b) Climbers. | <i>Symphorema involucrata.</i> |
| <i>Gnetum scandens.</i> | <i>Smilax macrophylla.</i> |
| (Dominant). | <i>Cansjera Rheedii.</i> |
| <i>Pueraria tuberosa.</i> | <i>Vitis repanda.</i> |
| <i>Hemidesmus indicus.</i> | <i>Capparis sepiaria.</i> |
| <i>Jasminum malabaricum.</i> | <i>Clematis hedysarifolia.</i> |

VEGETATION OF THE WAGRESHWAR PLATEAU

(Uncovered area 60%)

First Stratum:

- Dominants.
Erythrina indica.
Alsioedephne semicarpi-
folia.

Second Stratum:

- (a) Trees and Tall Shrubs.
Randia dumetorum.
Bridelia stipularis.
Bridelia Hamiltonii.
Grewia microcos.
Anacardium occidentale.
Bauhinia racemosa.
Woodfordia floribunda.
Casearia graveolens.

- Vitex negundo.*
Ixora coccinea.
Ixora nigricans.
Carissa carandas.
Zizyphus jujuba.
Zizyphus Oenoplia.
Zizyphus rugosa.
Lantana camara.
Santalum album.

- (b) Climbers and Scandent
 Shrubs.
Capparis horrida.
Capparis sepiaria.

Third Stratum of Shrubs:

- Pavetta indica.*

CHAPTER XXIV

THE VEGETATION OF WALLS

A preliminary study has been presented in this work; the authors have studied wall vegetation and its stages of development on walls in Bombay and mufusil places. Nasik,

Lonavla, Kalyan, Sion and Bandra. After a careful study of this type of vegetation, it was found that the optimum stage of development remained in certain choice grasses. *Arthroxon inermis* is a species common in 95 percent of the cases on record. However, in a couple of cases, this grass was not met with, and such records have been called facies of the Association of *Arthroxon inermis*. In two cases, *Tripogon bromoides* with *Linaria ramossissima* and *Leacanthus Wightii* were highly exclusive species of this Association. In one case *Lindenbergia urticifolia* with *Tripogon Jackquemontii* was the selective species. In all cases companion species were:—*Arundinella tennela*, *Chloris barbata*, *Eragrostis uiloides*, *Eragrostis tennela*, var. *pumilosa*, *Ageratum connyzoides*. *Cyperus rotundus*, *C. bulbosus*, *Kyllinga monocephala*, *Portulaca* sp. *Boerhaavia diffusa*, also *Oldenlandia corymbosa*, *Bonnaya* sp. and *Ficus* species were found to be common in the distribution of this Association.

From the higher cryptogamic forms, very often, present during the optimum stage of development were the species of *Adiantum* *Funaria* and *Polytricum*. *Anthoceros* sp. were common in green hollows in the walls with several forms of terrestrial Algae.

The soils on which the flora grows, is greyish in colour, loose in texture proving to be practically all nothing but humus accumulation with little percentage of floating particles of soil, coming by the blast of the wind. This layer with plant secretion dissolves the alluvial layer of Calcium Carbonate. This having come in contact with soil and water, gives fairly nutritive Calcium to plant life.

The analysis of soil for available Calcium, on the Calci-meter, was found to fluctuate between the percentage figures of 40 to 45 as the extremities in the whole bulk of the soil. In

the Deccan and the Sahiyadri Mountains, as against this percent, we have only 15 in crop soil. Such a high percentage of Calcium invites "Calciphilous communities" of plants.

Progress of Vegetation

The growth of vegetation on walls is usually effected in the following way. Due to the blowing of the wind, a certain amount of dust and dry soil is blown up so as to settle down in the crevices. In the rainy season, Algae and such other forms settle on the soil of the walls and get adopted for the growth of Mosses. As the Algae and Mosses decay, the soil increases in amount of humus content and becomes suitable for the growth of plants like Ferns. Generally, the seeds or the spores, as the case may be, of the surrounding plants can easily be brought in contact with the soil in the crevices of these walls. If the surrounding vegetation consists of Fern-like plants or plants having small light seeds, then the spores and seeds of all these plants can easily be carried in the crevices of the walls, where they can germinate. The most important thing for the growth of such plants is the presence of the essential elements and sufficient quantity of moisture in the soil of the crevices of the walls.

Successional Formation of a Wall Flora Type.

First Formation. Unicellular organisms, like *Pleurococcus*, *Chlorococcum*, *Trochiscia*, *Chlorochytrium*, *Navicula*, *Nostoc* etc. and many other Algae from *Anabena* onwards are the successional pioneers. There are plentiful Diatoms provoking by their presence for other unicellular organisms to share the substratum, eventually disorganising themselves.

Second Formation. By the accumulation of mucilage, moisture and humus, the substratum is ready to invite a higher community of plants, like the Lichens, Mosses, etc. The

spores of these floating about by the wind dash against the substratum and are imbibed into the living substratum formed by the first formation of unicellular plants. The Lichens, Mosses and the unicellular organisms in this formation may be seen to live together. This formation may also disharmonise the primary pioneer formation.

Third Formation. No sooner the second formation settles, a third formation, Pteridophytic in origin like the *Equisetums*, *Adiantums*, *Nephrolepis*, etc., begins to settle. We have on the Bombay walls been able to find *Adiantum lunulatum* and *Nephrolepis exaltata*.

By this good accumulation of humus, and looseness in the construction of the work of the walls the situation of the walls is ready to invite a fourth successional stage of vegetation—a characteristic vegetation that this paper tries to amplify.

Fourth Formation. This is the final formation of the plants comprising flowering herbs, grasses and woody stunted trees and their seedlings. There is a strong root-system in the members of this formation which penetrates into the soil. The Formation is typical flowering Formation.

Alphabetical List of Plants with short notes.

Acanthaceae.	<i>Rungia linifolia</i> , Lees. Shade loving.
Amarantaceae.	<i>Achyranthes aspera</i> , Linn.
	<i>Aerua lanata</i> , Juss.
	<i>Alternanthera sessilis</i> , Br. Perennial.
	<i>A. triandra</i> , Lam.
	<i>Amarantus spinosus</i> , Linn.
	<i>A. viridis</i> , Linn.
	<i>Celosia argentia</i> , Linn.
Anacardiaceae.	<i>Mangifera indica</i> , Linn Rare seedling.
Apocynaceae.	<i>Vinca alba</i> , Linn. Garden escape.
	<i>Vinca alba</i> , var. <i>rosea</i> , Garden escape.

Begoniaceae.	Begonia crinata, Shade and moisture.
Commelinaceae.	Commelina benghalensis, Linn. Shade and moisture.
	Cyanotis cristata, Schultz. Shade and moisture.
Compositae.	Ageratum conyzoides, Linn.
	Bidens pilosa, Linn.
	Blumea membranacea, D.C.
	Cosmos bipinnatus, Cav. Garden escape.
	Eclipta erecta, Linn.
	Tridax procumbens, Linn.
	Vernonia cinera, Less.
Convolvulaceae.	Convolvulus arvensis, Linn.
Cruciferae.	Brassica oleracea, Linn. Cuminal escapes.
	Lepidium sativum, Linn. Cuminal escapes.
Cucurbitaceae.	Cucumis melo. Cuminal escapes.
	Coccinia indica, W. & A. Cuminal escapes.
	Momordica charantia, Linn. Cuminal escapes.
Cyperaceae.	Cyperus bulbosus, Vahl.
	Cyperus rotundus, Linn.
	Kyllinga monocephala. Linn.
Euphorbiaceae.	Acalypha indica, Linn. (Vitality reduced).
	Euphorbia heterophylla. Heyne.
	E. pilulifera, Linn.
	E. thymifolia, Linn.
	Phyllanthus nerurii, Linn.
	P. urinaria, Linn.

- Ficoidae. *Mollugo oppositifolia*, Linn.
 M. pentandra, Linn.
 Trianthema monogyna, Linn.
- Graminae. *Arthroxon enermis*, Hook, f.
 A. lancifolius, Hoist.
 A. qurtinianus, Nash.
 Arundinella tennela, N. & W.
 Cenchrus, sp.
 Chloris barbata, S. W.
 C. quinquesetica, Bhide.
 Cynodon dactylon, Pers.
 Digitaria marginata, Linn.
 D. pedicellaris, Prain.
 Eleusine indica, Gaerten.
 Eragrostis pilosa, Beauv.
 E. tenella, Beauv. var. *pilosa*.
 E. uniloides, Nees.
 Ischemum semisagittatum, Roxb.
 Microchloa indica, Beauv.
 Oropetum Thomasum, Trin.
 Paspalum vaginatum, S. W.
 Themeda triandra, Forks.
 T. trimula, Hack.
 Tripogon bromoides, Roth.
 T. Jackquimonti, Stapf.
- Labiatae. *Ocimum sanctum*, Linn.
 Leucas aspera, Sprang.
- Leguminosae.
 (Caesalpinae). *Cassia tora*, Linn.
- (Mimosae). *Acasia arbica*, Linn.
- (Papilionaceae). *Alysicarpus buplurifolius*, Linn.
 Crotalaria prostrata, Roxb. Fls. not seen.
 Erythrina indica, Lamk. Seedlings only.

	Phaseolus Dalzelli, T. Cook.
Liliaceae.	Allium ampeloprasum, Linn. Cuminal escape.
	A. sativum, Linn. Cuminal escape.
Lythraceae.	Ammania baccifera, Linn.
	Lowsonia alba, Linn. Seedling.
	Punica granatum, Linn. Seedling.
Malvaceae.	Abutilon indicum, G. Don.
	Malachra capitata, Linn.
	Sida rhombifolia, Linn.
	Var. retusa, Masters.
	Urena sinuata, Linn.
Meliaceae.	Azadirachta indica, Linn.
Nyctaginaceae.	Boerhaavia diffusa, Linn.
	Bougainvillea spectabilis, Willd. Garden escape.
Oxalidaceae.	Oxalis corniculata, Linn.
Passifloraceae.	Passiflora foetida, Linn.
	Carica papaya, Linn. Garden escape.
Papaveraceae.	Argemone Mexicana, Linn.
Piperaceae.	Peperomia Wightiana, Niq.
Portulacaceae.	Portulaca oleracea, Linn. Moisture loving.
	P. quadrifida, Linn. Moisture loving.
Rhamnaceae.	Ziphyphus Jujuba, Lamk. Seedling only.
Rubiaceae.	Oldenlandia corymbosa, Linn.
Scrophulariaceae.	Bonnaya brachiata, Linn.
	B. oppositifolia, Spreng.
	B. veronicifolia, Spreng.
	Hygrophylla serpillum, T. Anders.
	Linaria ramossima, Lamk.

	<i>Lindenbergia urticifolia</i> .
	<i>Scoparia dulcis</i> , Linn.
Solanaceae.	<i>Capsicum annum</i> , Linn. Cuminal escape.
Tiliaceae.	<i>Corchorus acutangularis</i> , Linn.
	<i>Triumphetta pilosa</i> , Rith.
Turneraceae.	<i>Turnera ulmifolia</i> , Linn.
Umbelliferae.	<i>Coriandrum sativum</i> , Linn. Cuminal escape.
Urticaceae.	<i>Ficus asperima</i> , Roxb.
	<i>F. bengalensis</i> , Linn.
	<i>F. glomerata</i> , Roxb.
	<i>F. microphylla</i> , Leibin.
	<i>F. religiosa</i> , Linn.
	<i>F. repens</i> .
	<i>F. retusa</i> , Linn.
	<i>F. Tseila</i> .
	<i>Lecanthus Wightii</i> .
	<i>Fleurea interrupta</i> , Gaerten.
Verbenaceae.	<i>Lippia nudiflora</i> , Michaus.

List of Cryptogams on walls.

Adiantum lunulatum, Burn, *Funaria excurrentinervis*, Cardot. *Polytrichum strictum*, Banks. *Anthoeeros*, *Anabena*, *Chlorochytrium*, *Chlorococcum lobatum*, *Microcoleus*, *Navicula*, *Oedocladium*, *Phormidium*, *Pillularia boreatus*, Ehrb. *Pleurastrum*, *Pleurococcus*, *Protococcus*, *Trentiepholia*, *Trochiscia reticularia* (Reinsch) Hansq.

Conclusion

There grows a community of plants on walls during the monsoon months of the year, which is definite in its floristic composition. The dominant of this community is *Arthraxon inermis*, a species of grass, and is present in all wall formations. It is recommended that this particular association be called

"*Arthraxon inermis* Association" and if the environmental conditions remain the same, this species of grass will dominate other species. The other plants, very commonly found with this plant are *Arthraxon lancifolius*, *Chloris barbata*, *C. Quinquetica*, *Lecanthus Wightii*, *Tripogon bromoides*, *T. Jackquimonti*, *Linaria ramossissima*, and *Lindenbergia urticifolia*.

The hardness of the soil substratum and high percentage of Calcium content (CaCO_3 upto 45 per cent) of the soil are responsible for the growth of this Association on the walls. The elevation of the walls does not seem to play a part in the change of floristic composition of this Association.

By the study of successional stages of plant growth on walls, it is found that the pioneers are micro-organisms and the optimum final members are the flowering plants with the usual intermediate members of plants concurring with the Natural Systems of Classification of plants. Therefore, it can be deduced that the plant succession is a recapitulation of the evolution of plants higher from the lower.

The Association changes in its floristic composition as soon as the physical or chemical nature of the substratum changes.

CHAPTER XXV

POISONOUS PLANTS OF BOMBAY

- | | |
|---|----------------|
| 1. <i>Strobilanthes callosus</i> , Ness. | Acanthaceae. |
| 2. <i>Trichosanthes palmata</i> , Roxb. | Cucurbitaceae. |
| 3. <i>Kaempferia rotunda</i> , Linn, Willd. | Scitaminaceae. |
| 4. <i>Pythonium Wallichianum</i> , Kunth. | Aroidae. |
| 5. <i>Trichosanthes cucumerina</i> , Linn. | Cucurbitaceae. |
| 6. <i>Gloriosa superba</i> , Linn. | Liliaceae. |
| 7. <i>Cucumis trigonus</i> , Roxb. | Cucurbitaceae. |

- | | |
|--|-----------------|
| 8. <i>Terminalia belerica</i> , Roxb. | Combretaceae. |
| 9. <i>Strychnos nux-vomica</i> , Linn. | Loganiaceae. |
| 10. <i>Cerebera thevetia</i> , Willd. | Apocynaceae. |
| 11. <i>Amorphophallus companulatus</i> ,
Blume. | Aroidae. |
| 12. <i>Moringa pterigosperma</i> , Gaet. | Moringaceae. |
| 13. <i>Semecarpus anacardium</i> , Linn. | Anacardiaceae. |
| 14. <i>Plumbago rosea</i> , Linn. | Plumbaginaceae. |
| 15. <i>Anacardium occidentale</i> . Linn. | Anacardiaceae. |
| 16. <i>Alangium Lamarckii</i> Twait. | Cornaceae. |
| 17. <i>Corallocarpus epigeus</i> , Hook. | Cucurbitaceae. |
| 18. <i>Plumbago zeylanica</i> . Linn. | Plumbaginaceae. |
| 19. <i>Nerium odorum</i> , Solander. | Apocynaceae. |
| 20. <i>Calotropis gigantea</i> , Br. | Asclepiadaceae. |
| 21. <i>Datura fastuosa</i> . Linn. | Solanaceae. |
| 22. <i>Jatropha curcas</i> , Linn. | Euphorbiaceae. |

CHAPTER XXVI

PLANTS OF THE BERAR CIRCLE

- | | |
|-----------------|--|
| Ranunculaceae. | <i>Clematis triloba</i> , Heynesin Roth. |
| Anonaceae. | <i>Miliusa velutina</i> , H. f. and Thome. |
| | <i>Saccopetalum tomentosum</i> , Hook. |
| | <i>Anona squamosa</i> , Linn. |
| Menispermaceae. | <i>Cocculus villosus</i> , D.C. |
| | <i>Tinospora cordifolia</i> , Miers. |
| | <i>Cisampelos Pareira</i> , Linn. |
| Capparidaceae. | <i>Maerua arenaria</i> , Hook. f. Thoms. |
| | <i>Adapa indica</i> , Lamk. |
| | <i>Crataeva religiosa</i> , Forsk. |
| | <i>Capparis zeylanica</i> , Linn. |

- C. aphylla*, Roth.
C. grandis, Linn.
C. diversifolia, Wight and Arn.
C. horrida, Linn.
- Bixaceae. *Cochlospermum gossypium*, D.C.
Flacourtia Ramontchi, L. Herit.
- Portulacaceae. *Portulaca oleraceae*, Linn.
- Tamaricaceae. *Tamarix gallica*, Linn.
T. Dioica, Roxb.
T. ericoides.
- Malvaceae. *Sida rhombifolia*, Linn.
Hibiscus cannabinus, Linn.
H. esculentus, Linn.
H. ficulneus, Linn.
Thespesia lampas, Dalz & Gibson.
Gossypium herbaceum, Linn.
Kydia calycina, Roxb.
Bombax malabaricum, D.C.
- Sterculiaceae. *Sterculia urens*, Roxb.
S. villosa, Roxb.
S. colorata, Roxb.
Helicteris isora, Linn.
Erioleana Hookeriana, W. and A.
Waltheria indica, Linn.
- Tiliaceae. *Grewia salvifolia*, Heyne.
G. pilosa, Lam.
G. asiatica, Linn.
G. tileafolia, Vahl.
G. sobrophylla, Roxb (Syn. *sclero phylla*.)
G. abutifolia, Juss.
G. hirsuta, Vahl.
Triumpheta rotundifolia, Lam.

	<i>T. rhomboidea</i> , Jacq.
	<i>Corchorus olitorius</i> , Linn.
Malpighiaceae.	<i>Hiptage madablota</i> , Gaertn.
Zygophyllaceae.	<i>Tribulus terrestria</i> , Linn.
Rutaceae.	<i>Murraya exotica</i> , Linn.
	<i>M. Koenigii</i> , Sprang.
	<i>Feronia elaphantum</i> , Correa.
	<i>Ægle marmelos</i> , Correa.
Simarubaceae.	<i>Balanites Roxburghii</i> , Planch.
	<i>Ailanthus excelsa</i> , Roxb.
Burseraceae.	<i>Boswellia serrata</i> , Roxb.
	<i>Garuga pinnata</i> , Roxb.
	<i>Balsamodendron Mukul</i> , Hook.
Meliaceae.	<i>Melia Azedarach</i> , Linn.
	<i>Azadirachta indica</i> , A. Juss.
	<i>Soymeda febrifuga</i> , A. Juss.
	<i>Cedrela Toona</i> , Roxb.
	<i>Chloroxylon Sweitenia</i> , D. C.
Olacaceae.	<i>Olax scandens</i> , Roxb.
Celastraceae.	<i>Celastrus Paniculatus</i> , Willd.
	<i>Eleaodendron glaucum</i> , Pers.
Rhamnaceae.	<i>Ventilago madraspatana</i> , Gaertn.
	<i>Zizyphus jujuba</i> , Lam.
	<i>Z. coenoplea</i> , Mill.
	<i>Z. nummularia</i> , W. & A.
	<i>Z. zylopyrus</i> , Wild.
	<i>Z. rugosa</i> , Lamk.
Vitaceae	<i>Vitis vinifera</i> , Linn.
(Ampilidaceae.)	<i>V. linneai</i> , Wall.
	<i>V. quadrangularis</i> , Wall.
	<i>V. latifolia</i> , Roxb.
	<i>V. carnosae</i> , Wall.

- V. setosa, Wall.
 V. auriculata, Roxb.
 Leea macrophylla, Roxb.
 L. aspera, Edgew.
 Sapindaceae. Dodonea viscosa, Linn.
 Schlechera trijuga, Willd.
 Sapindus laurifolius, Vahl. (Soap-nut)
 Cardiospermum halicacabum, Linn.
 Anacardiaceae. Odina Woodier, Roxb.
 Spondias magnifera, Wild.
 Buchanania latifolia, Roxb.
 B. angustifolia, Roxb.
 Mangifera indica, Linn.
 Semecarpus anacardium, Linn.
 Moringaceae. Moringa pterigosperma, Gaertn.
 Leguminosae. Crotalaria juncea, Linn.
 (Papilionaceae.) C. sericea, Retz.
 Indigofera glauca, Willd.
 I. trita, Linn.
 I. Hauer, Forsk.
 I. tinctoria, Linn.
 I. pulchella, Roxb.
 Sesbania egyptiaca, Pers.
 Millettia auriculata, Baker.
 Tephrosia purpurea, Pers.
 T. villosa, Pers.
 Desmodium cephalotus, Wall.
 D. latifolium, D. C.
 Ougenia Dalbergioides. Benth.
 Aeschynomene indica, Linn.
 Abrus precatorius, Linn.
 Mucuna pruriens, D. C.
 Erythrina indica, Linn.

E. suberosa, Roxb.
Pueraria tuberosa, D. C.
Spatholobus Roxburghii, Benth.
Butea frondosa, Roxb.
B. superba, Roxb.
Clitorea ternatea, Linn.
Dolichos lablab, Linn.
Atylosia scaraboeoides, Benth.
Cylista scariosa, Roxb.
Rhynchosia sericea, Spanoghe.
R. minima, D. C.
R. cyanosperma, Benth.
R. viscosa, D. C.
Flemingia strobilifer, R. Br.
Dalbergia Sissoo, Roxb.
D. latifolia, Roxb.
D. paniculata, Roxb.
D. lanceolaria, Linn.
D. volubilis, Roxb.
Pterocarpus marsupium, Roxb.
Pongamia glabra, Vent.

II. *Ceasalpiniae*.

Caesalpinia Bonducella, Flem.
C. sapiaeria, Roxb.
C. pulcherima, Sw.
Poinciana regia, Bojer.
P. elata, Linn.
Parkinsonia aculeata, Linn.
Hardiwickia binata, Roxb.
Tamarindus indicus, Linn.
Cassia fistula, Linn.
C. siamea, Lam.
C. occidentalis, Linn.

Mimosae.

- C. sophora, Linn.
C. tora, Linn.
C. obtusifolia, Linn.
C. auriculata, Linn.
Bauhinia malabarica, Roxb.
B. racemosa, Lam.
B. purpurea, Linn.
B. variegata, Linn.
B. Vahlia W. et A.
Prosopis specigera, Linn.
Dichrostachys cinerea W. et A.
Mimosa rubicaulis, Lam.
M. hamata, Willd.
M. pudica, Linn.
Acasia farnesiana, Willd.
Acasia arabica, Wild.
A. eburnea, Wild.
A. leucophlea, Willd.
A. ferruginea, D. C.
A. Catechu, Willd.
A. caesia, Wild.
A. pennata, Wild.
A. concinna, D. C.
Albizzia procera, Benth.
A. odoratissima, Benth.
A. Lebeck, Benth.
A. amara, Boivin.
Pithocolobium dulce, Benth.
Terminalia Belerica, Roxb.
T. Chebula, Retz.
T. Arjuna, Bedd.
T. tomentosa, W. et Arn.
Combretum decandrum, Roxb.

Combretaceae.

- C. ovalifolium*, Roxb.
Quisqualis indica, Linn.
Anoguissus pendula, Edgew.
Anoguissus latifolia, Wall.
 Myrtaceae. *Eugenia jambolana*, Lam.
E. heyneana, Wall.
Barringtonia acutangula, Gaertn.
Careya arborea, Roxb.
 Lythraceae. *Lagerstroemia parviflora*, Roxb.
Woodfordia floribunda, Salisb.
Lawsonia alba, Law.
 Onagraceae. *Jussiaea suffruticosa*, Lum.
 Samydaceae. *Casarea graveolens*, Dalz.
C. tomentosa, Roxb.
 Passifloraceae. *Passiflora foetida*, Linn.
 Cucurbitaceae. *Trichosanthes palmata*, Roxb.
Momordica dioica Roxb.
M. cymbalaria, Fenzl.
Luffa acutangula, Roxb.
L. echinata, Roxb.
Bryonopsis laciniosa, Naud.
Coccinia indica, Wight.
Ctenolepis garcini, Naud.
 (Blastania garcinia, Cogn.)
Corallocarpus conocarpus, C. B. Clark.
 Cactaceae. *Opuntia Dillinii*, Haw.
 Cornaceae. *Alangium Lamarckii*, Thawaites.
 Rubiaceae. *Adina cordifolia*, Hook.
Stephegyne parviflora, Korth.
Hemenodictyon excelsum, Wall.
Gardenia latifolia, Ait.
G. lucida, Roxb.

- G. turgida*, Roxb.
Randia uliginosa, D. C.
R. dumetorum, Lamk.
Ixora parviflora, Vahl.
Hamiltonia swaveolens, Roxb.
Morinda tinctoria, Roxb.
Embelia ribes, Burma.
E. robusta, Roxb.
Sapotaceae. *Mimusops elengil*, Roxb.
M. hexandra, Roxb.
Bassia latifolia, Roxb.
Ebenaceae. *Diospyros chloroxylan*, Roxb.
D. melanoxylon, Roxb.
Cleaceae. *Nyctanthes arbor-tristis*, Linn.
Schrebeira sweitenoides, Roxb.
Jasminum arborescens Roxb.
Salvadoraceae. *Salvadora persica*, Linn.
Apocynaceae. *Carissa spinarum*, A. D. C.
C. carandas, Linn.
Plumeria acutifolia, Poir.
Holarrhena antidysentrica, Wall.
Wrightia tinctoria, A. Br.
W. tomentosa, A. Br.
Nerium odorum, Sol.
Asclepiadaceae. *Cryptolepis Buchnanian*, Roem & Sch.
Hemidesmus indicus, R. Br.
Holostemma Rheedii, Wall.
Calotropis gigantea, R. Br.
Calotropis procera, R. Br.
Oxystelma esculentum, R. Br.
Dregea volubilis, Benth.
Daemia extensa, R. Br.
Pergularia pallida, W. et A.

- Loganiaceae. *Leptadenia reticulata*, W. et A.
 Boraginaceae. *Ceropegia bulbosa*, Roxb.
 Strychnos nux-vomica, Linn.
 Cordia Macleodii, Hook.
 C. myxa, Linn.
 Ehretia levis, Roxb.
 Convolvulaceae. *Rhabdia lycioides*, Marl.
 Cuscuta reflexa, Roxb.
 Rivea ornata, Choisy.
 R. hypocrateriformis, Choisy.
 Lettsoma setosa, Roxb.
 Argeria serica, Dalz.
 Ipomea hederacea, C. Jacq.
 I. calycina, Benth.
 I. pentaphylla, Jacq.
 I. pes-tigredis, Linn.
 I. sepieria, Koen.
 I. turpethum. Br.
 Convolvulus parviflora, Vahl.
 Solanaceae. *Solanum indicum*, Linn.
 S. melongena, Linn.
 Physalis peruviana, Linn.
 Datura stramonium, Linn.
 D. fastuosa, Linn.
 D. crispa Seem.
 Bignoniaceae. *Dolicandron falcata*, Seem.
 Steriospermum chelonoides, D. C.
 S. suaveolens, D. C.
 S. xylocarpum, Benth.
 Oroxylum indicum, Vent.
 Millingtonia hortensis, Linn.
 Acanthaceae. *Hygrophylla spinosa*, T. Anders.
 Calophanes Dalzelli, T. Anders.

- Ruellia patula*, Jack.
Petalidium barlerioides, Nees.
Deadalacanthus roseus, T. Anders.
Strobilanthes callosus, Nees.
Barleria Prionitis, Linn.
B. Cristata, Linn.
B. montana, Nees.
Adhatoda vasica, Nees.
Verbinaceae. *Lantana camara*, Linn.
Vitex nigundo Linn.
V. trifolia, Linn.
V. leucoxylon, Linn.
Tectona grandis, Linn.
Clerodendron phlomoides, Linn.
C. serratum, Spreng.
Gmelina arborea, Roxb.
Labiatae. *Colebrookia oppositifolia*, Smith.
Amarantaceae. *Achyranthes aspera*, Linn.
Nyctaginaceae. *Bougainvillea spectabilis*, Willd.
Piperaceae. *Piper betle*, Linn.
Lauraceae. *Litsea serifera*, Pers.
(Syn *L. chinensis*,)
L. Polyantha, Juss.
(Syn *Tetrathema monopetala*, Roxb.)
Loranthaceae. *Loranthus longiflorus*, Ders.
L. loniceroides, Linn.
Viscum articulatum, Burn.
(*V. attenuatum*, D. C.)
Santalaceae. *Santalum album*, Linn.
Euphorbiaceae. *Euphorbia tirucalli* Linn.
E. Nivullia, Haw.
E. nerifolia, Linn.

- Bridelia retusa*, Spreng.
Cleistanthus collinus, Benth.
 (Syn. *Lepudieropsis orbicularis*, Muel.)
Antidesma Gharsembilla, Gaertn.
Fluggea microcarpa, Bl.
Phyllanthus reticulata, Poir.
P. emblica, Linn.
Glochidion velutinum, Wight.
Jatropha curcas, Linn.
J. gossipifolia, Linn.
Mallotus phillipensis, Muel.
Ricinus communis, Linn.
Baliospermum axillare, Bl.
 Urticaceae. *Holoptelia integrifolia*, Plaunch.
Trema politoria, Plaunch.
Ficus gibbosa, Bl. var. *parasitica*, King.
F. bengalensis, Linn.
F. religiosa, Linn.
F. infectoria, Roxb.
F. retusa, Linn.
F. hispida, Linn.
F. cunia, Ham.
F. glomerata, Roxb.
 Casuarinaceae. *Casuarina equisetifolia*, Forst.
 Salicaceae. *Salix tetrasperma*, Roxb.
 Scitamineae. *Musa superba*, Roxb.
 Dioscoreaceae. *Dioscorea bulbifera*, Linn.
D. daemona, Roxb.
D. pentaphylla, Linn.
D. oppositifolia, Linn.
 Liliaceae. *Gloriosa superba*, Linn.
Smilax microphylla, Roxb.
Asparagus racemosus, Willd.

Palmaceae.

Phoenix sylvestre, Roxb.
P. acaulis, Buch.
Borassus flabelifer, Linn.

CHAPTER XXVII

VEGETATION OF SINDH.

Acasia arabica.
Prosopis specigera.
Dalbergia latifolia.
Albizzia lebbeck.
Sapium sebiferum.

Tamarix articulata,
Capparis aphylla.
Salvadora persica.
Alhagi camelorum.
Sueda maritima.
Withania coagulans.

Trees and Shrubs of the Lonaola and Karla Groves.

Ranunculaceae.

Clematis hedysarifolia, D. C.
C. triloba.

Cappardaceae.

Capparis Moonii, Wight.
Crataeva religiosa, Forsk.

Malvaceae.

Thespesia populnea, Soland.
Bombax malabaricum, D. C. Sair.
Thespesia Lampas, Dalz & Giibs.
Bombax insigne, Wall.

Sterculiaceae.

Sterculia gutata, Roxb.
S. colorata, Roxb.

Tiliaceae.

Grewia tiliaefolia, Vahl.

Malpighiaceae.

Hiptage madablota, Gaertn.
Aspidopteris cordata, A. Juss.

Rutaceae.

Zanthoxylum Thetsa, D. C.
Glycosmis pentaphylla, Correa.
Atalanta racemosa, W. & A.

Burseraceae.	<i>Garuga pinnata</i> , Roxb.
Meliaceae.	<i>Dysoxylum binectariferum</i> , Hook.
Celastraceae.	<i>Celastrus paniculatus</i> , Willd. <i>Gymnosporia emarginata</i> , Grath.
Rhamnaceae.	<i>Ventilago madraspatena</i> , Gaertn. <i>Zizyphus rugosa</i> , Lamk.
Sapindaceae.	<i>Allophyllus Cobbe</i> , Blumé. <i>Schleicchera trijuga</i> , Willd.
Anacardiaceae.	<i>Mangifera indica</i> , Linn. <i>Semecarpus anacardium</i> , Linn. <i>Holigarna Grahamii</i> , Hook.
Leguminosae.	<i>Crotalaria retusa</i> , Linn. <i>Erythrina stricta</i> , Roxb. <i>Butea frondosa</i> , Konig. <i>Dalbergia sympathetica</i> , Nimmo. <i>Pongamia glabra</i> , Vent. <i>Mezoneuron cuculatum</i> , W. and A. <i>Saraca indica</i> , Linn. <i>Tamarindus indicus</i> , Linn. <i>Entada scandens</i> , Bth. <i>Acasia concinna</i> , D.C. <i>Albizzia stipulata</i> , Boiv.
Combretaceae.	<i>Terminalia belerica</i> , Roxb. <i>T. Chebula</i> , Retz. <i>Calycopteris floribunda</i> , Lam. <i>Combretum ovalifolium</i> , Roxb. <i>C. extensum</i> , Roxb.
Myrtaceae.	<i>Psidium Guyava</i> , Linn. <i>Eugenia jambolana</i> , Lam.
Melastomaceae.	<i>Memecylon edule</i> , Roxb.
Cactaceae.	<i>Opuntia nigricans</i> , Haw.
Rubiaceae.	<i>Stephegyne parviflora</i> , Korth.

	<i>Randia dumetorum</i> , Lamk.
	<i>Canthium umbellatum</i> , Wight.
	<i>Vanguiria spinosa</i> , Roxb.
	<i>Ixora parviflora</i> , Vahl.
	<i>I. nigricans</i> , Br.
	<i>Pavetta indica</i> , Linn.
Compositae.	<i>Vernonia indica</i> , Clarke.
Sapotaceae.	<i>Sideroxylon tomentosum</i> , Roxb.
	<i>Mimusops Elengii</i> , Linn.
Ebenaceae.	<i>Diospyros montana</i> , Roxb.
Oleaceae.	<i>Jasminum arborescens</i> , Roxb.
	<i>Linoceira intermedia</i> , Wight.
	<i>Olea dioica</i> , Roxb.
Apocynaceae.	<i>Carissa Carandas</i> , Linn.
	<i>C. suavissima</i> , Bedd.
	<i>Rouwolfia densiflora</i> , Benth.
	<i>Wrightia tinctoria</i> , Br.
	<i>Anodendron paniculatum</i> , A. D. C.
Boraginaceae.	<i>Cordia myxa</i> , Linn.
Bignoniaceae.	<i>Heterophragma Roxburghii</i> , DC.
	<i>Steriospermum chelonoides</i> , D.C.
Acanthaceae.	<i>Strobilanthes ixiocephalus</i> , Benth.
	<i>Adhatoda Vesica</i> , Nees.
Verbenaceae.	<i>Lantana camara</i> , Linn.
	<i>Callicarpa lanata</i> , Linn.
	<i>Premna coreacea</i> , Clarke.
	<i>Vitex Negundo</i> , Linn.
Labiatae.	<i>Colebrookia oppositifolia</i> , Linn.
Lauraceae.	<i>Machilus macranthus</i> , Nees.
Thymeliaceae.	<i>Lasiosiphon eriocephalus</i> , Dene.
Eleagnaceae.	<i>Eleagnus latifolia</i> , Linn.
Loranthaceae.	<i>Loranthus longiflorus</i> , Desrous.
	<i>L. loniceroides</i> , Linn.

	<i>Viscum capitellatum</i> , Sm.
Santalaceae.	<i>Osyris arborea</i> , Wall.
Euphorbiaceae.	<i>Euphorbia nerifolia</i> , Linn.
	<i>Bridelia retusa</i> , Spreng.
	<i>Glochidion lanceolarium</i> , Dalz.
Urticaceae.	<i>Holoptelia integrifolia</i> , Planch.
	<i>Celtis tetrandra</i> , Roxb.
	<i>Morus alba</i> , Linn.
	<i>Ficus gibbosus</i> , Bl.
	<i>F. benghalensis</i> , Linn.
	<i>F. mysorensis</i> , Heyne
	<i>F. retusa</i> , Linn.
	<i>F. religiosa</i> , Linn.
	<i>F. Tsiela</i> , Roxb.
	<i>F. asperrima</i> , Roxb.
	<i>F. glomerata</i> , Roxb.
	<i>Artocarpus integrifolia</i> , Linn.
Salicaceae.	<i>Salix tetrasperma</i> , Roxb.
Gnetaceae.	<i>Gnetum scandens</i> , Roxb.
Palmaceae.	<i>Caryota urens</i> Linn.
Graminaceae.	<i>Bambusa arundinaceae</i> , Retz.
	<i>Oxytenanthera monostigma</i> , Bedd.

CHAPTER XXVIII

THE FLORA OF CUTCH

Geography:—The Province of Cutch extends from 20"—47' to 24" N. Lat and 68"—25' to 71". 10' E. Long, being crossed by the parallels of the Tropics of Cancer about 25 miles North of the Capital, Bhuj. On the North-east and

South-east it is bounded by the Rann of Cutch; on the South by the Gulf of Cutch, on the West by the Arabian sea, and on the North-west by the eastern branch of the Indus. Its extreme length from east to west is 160 miles, and its extreme breadth 70 miles from north to south, while in one place, it is only 35 miles wide. It contains about 6,500 square miles, exclusive of the Grand Rann, which including the islands with the portion bounded by the Gujerat coast in the east and south east, covers an area of 10,000 square miles. Perhaps the most striking feature to the visitor of Cutch is the sterility of the country. Sandy plains and naked rocky hills present a strong contrast to the more fertile parts of India. The barrenness is increased by the scarcity of trees and general absence of anything that can be called jungle. The Bombay Gazeteer describes it as follows:—"From the sea on the south-west and from the Rann on the north and east, the coast of Cutch is in some places very slightly raised and fringed with Mangrove swamps. In other parts, it rises in rows of sandy hills, or as in the North-west, is broken by rocky cliffs. Inland, especially on the south and east, are broad plains, some deep soiled and well tilled, others bare and furrowed with water-courses. Beyond these plains rise the central lands of the province, in places relieved by bright coloured rocks and patches of tillage, but over most of the area brown waving uplands deep in loose sand, broken by naked peaks, and bordered by bare ridges of low dust-coloured hills." There are no rivers that have enough water to flow throughout the year. The river courses are mere channels for conveying the periodical floods from the central uplands to the sea and Rann respectively. The Khari which rises in the Chorad Hills, about eight miles south-west of Bhuj, has a course about thirty miles. Flowing past Bhuj and winding its way between steep banks, in places 110 feet high, it keeps north and loses itself in the Rann.

The largest rivers that have a southern direction are the Madh and the Tera. They flow for about 30 miles across the Abdasa plain and fall together into the Gulf of Cutch. Owing to the fact that almost all the rocks are impregnated with salts, the water of the Cutch streams is unfit to drink, and during the hot season is too salt even for cattle. This circumstance has to do a great deal with the character of the present flora. Water is usually found at no great depth from the surface. Many wells bring 15 to 45 feet deep yield sufficient supplies. The ponds which are not uncommon, are mostly small and usually run dry in six months."

Climate:—The average rainfall is 14.30 inches at Bhuj, the maximum registered being 34.88 inches in 1862, and the minimum 1.10 in 1848. The rain is concentrated in the four months of June, July, August, and September. There may be slight rain in October.

Temperature:—The highest reached is 101 in May and the lowest is 54 in January.

The following list contains the indigenous plants as well as those that are cultivated. Cul.—Cultivated. C—Common. V.C.—Very Common. Rare.

- | | |
|------------------------|---|
| Magnoliaceae. | <i>Michelia Champaca</i> , L. Cul. |
| Anonaceae. | <i>Polalthia longifolia</i> , Benth & Hook. Not indigenous. |
| | <i>Anona squamosa</i> L. Cul. |
| | <i>A. reticulata</i> , L. Cul. |
| Menispermaceae. | <i>Tinospora cordifolia</i> , Miers. |
| | <i>Cocculus villosus</i> , D.C. Not Common. |
| | <i>C. loeba</i> , Dc. Rare. |
| | <i>Stephania hernandifolia</i> , Walp. Rare. |
| Nympheaceae. | <i>Nymphaea lotus</i> , L. Very rare. |
| | <i>N. stellata</i> , Willd. Rare. |

- Fumariaceae.** *Fumaria parviflora*, Lam. In cultivated fields.
- Cruciferae.** *Farsetia jacquemontii*, Hook, V.C.
Moricandra tortuosa, Hook. Rare.
- Capparidaceae.** *Cleome monophylla*, L. Rare.
C. papillosa, Steud.
C. stocksiana, Bois.
C. brachycarpa, Vahl.
Gynandropsis pentaphylla, D.C. Common in waste places.
Maerua ovalifolia, Cambess. Rare, in hedges.
Cadaba indica, Lam. Rare in hedges.
Capparis spinosa, L. N.C.
C. spinosa, L. var *galeata*, Hook.
C. aphylla, Roth, V.C.
Capparis sepiaria, L, Rare.
C. horrida, L. Not Common.
- Resedaceae.** *Reseda pruinosa*, Delile. Rare.
R. aucheri, Bois. Rare.
- Violaceae.** *Viola stocksii*, Bois.
- Polygalaceae.** *Polygala erioptera*, D.C. On dry cultivated ground.
P. elongata, Klein. On sandy cultivated ground.
P. irregularis, Bois. On sandy tilled soil.
- Caryophyllaceae.** *Polycarpea corymbosa*, Lam. On sandy ground.
P. spicata, Wight. On sandy soil.
- Portulacaceae.** *Portulaca oleracea*, L. & Common weed.
P. quadrifida, L. Common.
P. tuberosa, Roxb. On sandy soil.

Common.

Tamaricaceae.

Tamarix dioica, Roxb. In river beds.
T. ericoides, Rttl. Rarer than *T. dioica*.

Elatinaceae.

Bergia odorata, Edgew.

Malvaceae.

Althea ludwigii, L.

Malva parviflora, L. About human habitation.

Sida veronicifolia, Lam. Very common on sandy soil.

Sida spinosa, L.

Sida rhombifolia, var. *retusa*, Masters, V.C.

Abutilon indicum, Sweet. V.C.

A. muticum, Sweet. Common.

A. graveolens. W. & A. Not common.

Malachra capitata, L.

Urena sinuata, L.

Pavonia glecomifolia, Gareke. In sheltered places, in hedges and bushes.

Pavonia zeylanica, Cav. Common.

P. odotata, Willd. Common.

Hibiscus trionum, L.

H. micranthus, L. Common.

H. intermedius, A. Rich. Common.

H. solandra, L'Her.

H. caesius, Garcke.

H. punctatus Dalz.

H. esculentus, L. cultivated.

Thespesia populnea, Poland. Not wild.

Gossypium stocksii, Mast.

G. herbaceum, L. var.

G. arboreum, L.

- Sterculiaceae.** *Melhania tomentosa*, Stocks.
Waltheria indica, L. Not Common.
- Tiliaceae.** *Grewia populifolia*, Vahl. Common.
Grewia villosa, Willd. Common.
Triumfetta rhomboidea, Jacquin. Common.
T. rotundifolia, Lam. Common.
Corchorus olitorius, L. Common.
C. antichorus, Raensch. Common.
C. acutangularis, Lam.
- Malpighiaceae.** *Hiptage madablota*, Gaertn.
- Zygophyllaceae.** *Tribulus terrestris*, L. Common.
T. alatus, Delile.
Seetzenia orientalis, Dene.
Peganum harmala, L.
Zygophyllum simplex, L.
Fagonia cretica, L. Very common.
- Geraniaceae.** *Monsonia senegalensis*, Guil. Pretty common.
Oxalis corniculata, L. Cosmopolitan.
Murraya koenigi, Spreng. In gardens.
Citrus medica, L. Var *medica*. In gardens.
C. medica, L. var. *limeta*, Sweet Lime—In gardens.
C. medica L. var. *acida*, Sour Lime—In gardens.
C. aurantium, L. Orange. In gardens.
C. decumana, Murr. Pomelo. In gardens.
Feronia elephantum. Corr.—In gardens.
- Simarubaceae.** *Balanites roxburghii*, Planch. Common.
- Burseraceae.** *Commiphora mukul*, Engl.—Pretty Common.

- Meliaceae.** *Melia azedarach*, L. In gardens.
- Celastraceae.** *Azadirachta indica*, A. Juss.—In gardens.
- Gymnospora montana*, Benth.—On rocky ground, not common.
- Rhamnaceae.** *Zizyphus jujuba*, Lamk. Very common.
- Z. rotundifolia*, Lamk. Not common.
- Z. enoplea*, Mill. Not common.
- Vitaceae.** *Vitis trifoliata*, L. Not common.
- Sapindaceae.** *Sapindus laurifolius*, Vahl. Cultivated.
- Anacardiaceae.** *Rhus mysorensis*, Heyne. Not common
—on stony dry slopes.
- Mangifera indica*, L. Cultivated.
- Moringaceae.** *Moringa pterigosperma*, Gaertn. Cultivated near villages in tilled soil.
- Leguminosae.** *Crotalaria burhia*, Ham. Common in sandy places.
- (Papilionaceae). *C. retusa*, L. Common.
- C. jariaunceae*, L. Common.
- C. medicaginea*, Lam. var *neglecta*, Baker.
- Crotalaria notonii*, W. & A. On sandy soil.
- Melilotus indica*, All.
- Medicago sativa*, L. Cultivated.
- Lotus garcinii*, D.C.
- Indigofera linifolia*, Retz. Common.
- I. enneaphylla*, L. Common.
- I. anabaptista*, Steud.
- I. paucifolia*, Delile. Common.
- I. trifoliata*, L. Not common.
- I. articulata*, Gauan.
- I. tenuifolia*, Rottl.
- I. parviflora*, Heyne. Rare.

I. tinctoria, L. Not common.
I. hirsuta, L. Not common.
Tephrosia tenuis, Wall.
T. purpurea, Pers. In sandy places.
T. villosa, Pers. var. *incana*, Baker. Common in sandy places.
T. senticosa, Pers. In sandy places.
Sesbania egyptiaca, Poir. var. *bicolor*.
S. aculeata, Poir. Very common.
Taverneira nummularia, D.C.
Alhagi camelorum, Fisch. Not common.
Zornia diphylla, Pers. Very common.
Alysicarpus vaginalis, D.C.
A. longifolius, W. & A.
A. rugosus, D.C. var. *styracifolius*. Baker.
Abrus precatorius. L. not common.
Butea frondosa, Koenig. Rare.
Phaseolus trilobus, Ait.
P. vulgaris, L. Cultivated.
P. mungo, L. var. *roxburghii*, Prain.
Cultivated in the rainy season.
P. aconitifolius. Jacquin. Same as above.
Clitorea ternatea, L. Common in hedges.
Dolichos lablab, L. Cultivated.
Rhynchosia minima, D.C. Common in hedges.
Pongamia glabra, Vent. Planted.
Cajanus indicus, Spreng. Cultivated.
Cicer arietinum, L. Very little cultivated.
Caesalpinia bonducella, Flemming. Not common.
C. pulcherima, Swartz. Cultivated.
Poiciana elata, L. Planted.

Caesalpinac.

P. regia, Bojer. Planted.
Parkinsonia aculeata, L. Naturalized.
Cassia occidentalis. Not common.
C. sophora, L. Not common.
Cassia tora, L. Not common.
Cassia auriculata, L.
C. obtusa, Roxb. Not common.
C. holoserica. Fresen.
C. pumila, Lamk. Vrey common.
Tamarindus indicus, L. Not common.
 Cultivated about villages.
Bauhinia racemosa. Lamk. Rare.
Prosopis specigera, L. Very common.

Mimosae.

Dichrostachys cinerea, W. & A. Rare, on
 dry stony ground.
Mimosa rubicaulis, Lamk.
M. hamata, Willd. Common.
Acasia arabica, Willd. Very common.
A. farnesiana. Willd. Not indigenous.
Acasia eburnea, Willd. Pretty common.
A. jacquemonti, Benth. Rare.
A. leucophlea, Willd. Common.
A. catechu, Willd, var. *sundra*, Prain.
 Pretty Common in bushy localities.
Albizzia lebbek, Benth. Planted in garden
 and near wells.

Rosaceae.

Potentilla supina, L.

Saxifragaceae.

Vahlia viscosa, Roxb.

Holoragidaceae.

Myriophyllum intermedium, D.C. In
 ponds.

Rhizophoraceae.

Rhizophora mucronata, Lamk. In salt
 marshes along the coast.

- R. conjugata, L. Less common than the above.
- Bruguira gymnorhiza, Lamk. In salt marshes and tidal creeks.
- Myrtaceae.** Eugenia jambolana, Lamk. In gardens and near wells.
- Psidium guyava. Cultivated.
- Lythraceae.** Ammania baccifera, L.
- A. salicifolia, Monti.
- Lowsonia inermis, L. Growing wild and cultivated.
- Punica granatum, L. Cultivated.
- Cucurbitaceae.** Trichosanthes anguina, L. Cultivated.
- Momordica charantia, L. Cultivated.
- M. balsamina, L.
- Luffa egyptiaca, Mill. In gardens.
- Luffa echinata, Roxb.
- Cucumis trigonus, Roxb. Common.
- C. melo, L. var agrestis Naud. Common.
- C. melo, L. cultivated.
- Bryonopsis laciniosa, Naud, Not common.
- In hedges.
- Citrullus colcocynthis, Schrader. Pretty common.
- C. vulgaris, Schrad. Cultivated.
- Coccinia indica. W. & A. Very common,
- In hedges.
- Melothria madaraspatena, Cogniaux.
- Common in hedges and bushes.
- Blastania garcinia, Cogniaux, Not common.
- Corallocarpus epigeus, C. & B. Clarke.
- Pretty common.

- Lagenaria vulgaris*, Seringe. Cultivated.
Cucurbita moschata, Seringe. Cultivated.
Cucurbita maxima, Duchesne. Cultivated.
Cucurbita pepo, L. Cultivated.
- Cactaceae.** *Opuntia dillinii*, Haw. Not common; used for hedges.
- Ficoidae.** *Trianthema monogyna*, L. Very common.
T. triquetra, Rottl. & Willd. Very common.
T. pentandra, L. Common.
Orygia decumbens, Forsk.
Mollugo hirta, Thumb. Not common. In dried up water holes.
Gisekia pharmacoides, L. Rare.
- Umbelliferae.** *Daucus carota*, L. Cultivated.
Coriandrum sativum, L. Cultivated.
- Rubiaceae.** *Spermacoce stricta*, L. Rare.
- Compositae.** *Vernonia cinera*, Less. Very common.
Adenostemma viscosum, Forest. Common near water courses in gardens and fields.
Grangea madaraspata, Poir.
Blumea amplexans, D.C.
Pluchia tomentosa, D.C.
P. wallichiana, D.C. Not common.
P. arguta, Bois. Not common in stony ground and by the side of water courses.
Sphearanthus indicus, L. Rare. In moist ground.
Gnaphalium luteo-album, L.
G. indicum, L.

- Inula grantioides*. Bois. Common on rocky ground.
Vicoa auriculata, Cas.
Pulicaria angustifolia, D.C. Common in sandy soil.
Seigesbeckia orientalis, L.
Eclipta erecta, L.
Blainvillea rhomboides. Cass.
Bidens pilosa, L.
Echinops echinatus, Roxb.
Volutarella divaricata, Benth & Hook.
Dicoma tomentosa, Cass.
Lactuca remotiflora, D.C.
Launea pinnatifida, Cass. Common.
Goodeniaceae. *Scaevola Koenigii*, Vahl. On the sea coast.
Plumbaginaceae. *Statice stocksii*, Bois.
Primulaceae. *Anagallis arvensis*, L. Rare.
Myrcinaceae. *Ægecerus majus*, Gaerten. On the sea coast.
Sapotaceae. *Mimusops elengii*, L. Cultivated.
M. hexandra, Roxb. Cultivated in gardens and near wells.
Oleaceae. *Jasminum sambac*, Ait. Cultivated.
Salvadoraceae. *Salvadora persica*, L. Very common.
S. oleoides, Decaisne. Common.
Apocynaceae. *Nerium odorum*. Soland. Grown in gardens, found as an escape in some places.
Plumeria acutifolia, Poir. Cultivated.
Asclepiadaceae. *Periploca aphylla*, Decaisne. Common on rocky ground.

Glossonema varians Benth.
Calotropis procera, R. Br. Very common.
Oxystelma esculentum, R. Br.
Pentatropis microphylla, W. & A. Very common.

Daemia extensa, R. Br. Very common.
Sarcostemma brevistigma, Wight. Common in stony places.

Leptadenia reticulata, W. & A. Rare.
L. spartum, Wight. Very common.

Gentianaceae.

Enicostemma littorale, Blume. Common.

Boraginaceae.

Cordia myxa, L. Pretty common in gardens and near wells.

Cordia Rothii, Roem & Schult. Very common.

Coldenia procumbens, L.

Heliotropium zeylanicum, Lam. Common.

H. supinum, Common.

H. paniculatum, R. Br. Rare.

Tricodesma indicum, R. Br. Common.

T. zeylanicum R. Br. Common.

Sericostema pauciflorum, Stocks.

Arnebia hispidissima, D.C.

Convolvulaceae.

Cuscuta reflexa, Roxb.

Cuscuta chinensis, Lamk. Common.

Cressa cretica, L. Not common.

Evolvulus alsinoides, L. Very common.

Breweria latifolia, Benth.

Convolvulus rottlerianus, Choisy. Not common.

C. microphyllus, Sieb. Very common in sandy soil.

C. glomeratus, Choisy.

C. arvensis, L. Common in cultivated ground.

Merremia hastata, Hallier. Rare.

Ipomea pentaphylla, Hallier. Not common.

I. pilosa, Sweet. Common.

I. biloba, Forsk.

I. pes-tigredis, L. Very common on sandy ground.

I. aquatica, Forsk. In ponds. Not common.

Rivea hypocrateriformis, Choisy. Common.

Argeria speciosa, Sweet. In gardens.

Solanaceae.

Solanum nigrum, L. In cultivated ground.

S. xanthocarpum Schrad & Wend.

S. indicum, L. Common.

S. trilobum, L. Not common.

S. tuberosum, L. Cultivated.

S. melongena, L. Cultivated.

Withania somnifera, Dunal, Rare.

Lycium barbatum. L. Common.

Datura fastuosa, L. var *alba*, C. B. Clarke. Common.

Lycopersicum esculentum, Mill Cultivated.

Nicotiana tabacum, L. Cultivated.

Capsicum frutescens, L. Cultivated.

Scrophulariaceae.

Celsia coromandeliana, Vahl.

Linaria ramosissima, Wall. Prtety common in rocky places.

Veronica anagallis, L.

- Orobancheaceae.** *Lindenbergia urticifolia*, Link & Otto.
Bignoniaceae. *Orobanche aegyptiaca*, Pers.
Tecomella undulata, Seem. Not common.
Millingtonia hortensis, L.f. In gardens.
Pedaliaceae. *Pedaliium murex*, L. Very common.
Sesamum indicum, L. Cultivated.
Acanthaceae. *Blepharis sindica*, T. Anders.
Asteracanthus longifolia, Nees. Common.
Ruellia patula, Jacq.
Barleria prionitis, L. Common.
B. cristata, L. var. *dichotoma*, Probably cultivated.
Lepidaghatia cristata, Willd. Common.
Rungia repens, Nees. Common.
Justicia heterocarpa, T. Anders.
J. diffusa, Willd.
J. simplex, D. Donn.
Peristrophe bicalyculata, Nees.
Verbenaceae. *Lippia nodiflora*, Michaux, In sandy soil.
Premna integrifolia, L. Near the coast.
Clerodendron phlomoides, L.f. Not common. In hedges.
Avicennia officinalis, L. Along the coast.
In salt marshes and tidal creeks of India.
Labiatae. *Ocimum sanctum*, L. Probably cultivated.
O. canum, Sims.
O. basilicum, L. Cultivated.
Anisomelis ovata, R. Br.
Leucas urticifolia, R. Br.
L. linifolia Spreng. Common.
L. Cephalotus, Spreng. Common.
Salvia aegyptiaca, L. var. *pumila*. Hook. f.

- Nyctaginaceae.** *Boerhaavia diffusa*, L. Very common.
B. rapanda, Willd. Very common.
B. verticillata, Poir. Very common.
Bougainvillea spectabilis, Willd. Cultivated.
- Amarantaceae.** *Celosia argentea*, L. Pretty common.
Amarantus gangeticus, L. var *trista*, Prain. Cultivated.
A. blitum, Var *oleracea*. Hook. f. Cultivated.
A. viridis L. In gardens.
A. polygamus, L. In cultivated ground.
A. tenuifolius, Willd.
Ærua javanica, Juss. Very common.
Ærua monsoniae, Mart. Very common.
Nothosearua bracheata, Wight.
Achyranthes aspera, L. Common.
Pupalia atropurpurea, Moq.
P. lappacea, Moq.
Alternanthera triandra, Lam.
- Chenopoliaceae.** *Atriplex stocksii*, Bois.
Salicornia brachiata, Roxb.
Sueda fruticosa, Forsk.
S. nudiflora, Moq.
Holoxylon recurvum, Bunge.
Salsola foetida, Del.
- Polygonaceae.** *Polygonum plebejum*, R. Br. var. *indica*, Hook. Common.
P. glabrum, Wild.
- Aristolochiaceae.** *Aristolochia brachiata*, Retz.
Euphorbia nerifolia, L. Very common, on rocky ground.

- E. hypericifolia*, L. var. *parviflora*. Very common.
E. pilulifera, L. Common.
E. thymifolia, L. Very common.
E. tirucalli, L. Common in hedges.
Fluggea leucopyrus, Willd.
Phyllanthus reticulatus, Poir.
P. madaraspatisensis, L.
P. neruri, Common.
Chrozophora prostrata, Dalz.
Ricinus communis, Cultivated.
- Urticaceae.** *Ficus beghalensis*, L. Planted.
F. retusa, Planted.
F. religiosa, L. Planted.
F. Tsiela, Roxb. Planted.
- Ceratophyllaceae.** *Ceratophyllum demersum*, L. In tanks and ponds.
- Hydrochritaceae.** *Hydrilla verticillata*, Presl. In tanks.
Vallisneria spiralia, L. In tanks.
- Liliaceae.** *Asparagus racemosus*, Willd. var. *javanica*, Baker.
Asphodelus tenuifolius, Cav.
Allium sepa, L. Cultivated in the cold season.
A. sativum, L. Cultivated.
- Commelinaceae.** *Commelina nudiflora*, L. Common.
C. benghalensis, L. Common.
- Palmaceae.** *Phoenix sylvestris*, Roxb. Cultivated.
Cocos nucifera, L. Cultivated.
- Pandanaceae.** *Pandanus tectorius*, Soland. Planted along the sea coast.
- Aroidaceae.** *Colocasia antiquorum*, Schott. Rare.

Lemnaceae.

Wolffia arrhiza, Wimm. In tanks.

Niadaceae.

Potamogeton indicus, Roxb. In ponds and tanks.

Naias minor. All in still sweet water.

Cyperaceae.

Kyllinga triceps, Rottb.

Pycnus polystachys, Beauv. Near the coast.

Cyperus haspan, L.

C. arenarius, Retz. On the sea coast.

C. conglomeratus, Rottb.

C. iria, L. In Rice fields.

C. bulbosus, Vahl.

C. stoloniferus, Retz. On the sandy sea shore.

C. pygmaeus, C.B. Clarje.

Eleocharis plantaginea, Br.

Fimbristylis tetragona, Br.

F. dichotoma, Vahl.

F. ferruginea. Vahl.

F. spathaceae. Roth.

Scirpus supinus, L.

S. grossus, L.

S. littoralis, Schrad.

Graminaceae.

Paspalum distichum, L. On the sea shore.

P. sanguinale, Lamk.

Panicum colonum, L.

Panicum turgidum, Forsk.

Panicum crus-galli, L. var. *frumentaceum*.
Cultivated.

Spinifex squarrosus, Kunth. On the sandy coast.

Pennesetum typhoideum, Rich. Cultivated.
P. dichotomum, Delile. On sand hills.
P. setosum, Rich.
P. cenchroides, Rich.
Cenchrus biflorus, Roxb.
Trachys mucronata, Pers. On the sea-shore.
Tragus racemosus, Hall.
Hygrophiza aristata, Nees. (Water-grass).
Saccharum spontaneum, L.
S. officinarum, L. Cultivated.
S. arundinaceum, Retz.
Ischemum pilosum, Dalz & Gibson.
Eleonurus royleanus, Nees.
Andropogon foveolatus, Del.
A. sorghum, Brot. Cultivated.
A. annulatus, Forsk.
Aristida adscensionis, L.
A. funiculata, Trin and Rupr.
Gracilea royleana, Nees.
Cynodon dactylon, Pers.
Chloris barbata, Swar.
Eleusine aegyptiaca, Pers.
Leptochloa chinensis, Nees.
Phragmites karka, Trin.
Eragrostis ciliaris, Link.
Halopyrum mucronatum, Stapf.
Æluropus villosus, Trin. On salt ground.
Triticum vulgare, L. Cultivated.
Hordeum vulgare, L. var. *hexastichon*, Aitchis. Cultivated.

The following remarks apply only to the indigenous plants of which our catalogue contains 345 species. These belong to 74 Natural Orders. The dominant orders of the Cutch Flora are roughly taken the same as those of Kooker's Indus Plain Province. The Leguminosae stand first with 67 species; then there follow the Graminaceae with 35, the Malvaceae, with 24, the Compositae with 22, the Cyperaceae, with 17, the Convolvulaceae with 17, the Cucurbitaceae with 15, the Amarantaceae with 13, the Capparidaceae with 12, the Acanthaceae and Solanaceae with 11 species. It is very probable that a more thorough exploration of the country will change the rank of some Orders. Of the 345 indigenous plants about 30 only are trees, 95 shrubs and under-shrubs; all the rest are herbs, mostly perennials. Almost all the plants have a wide geographical distribution with regard to the Indian as well as to the Extra Indian region. No endemic species have been found as yet. Cutch has over 200 species in common with Sind and about 160 with Gujerath. Of the latter about 70 do not occur in Sind, whilst of the former over 80 have not been found in Gujerath.

If we consider that Cutch is a country with a long dry season, that the soil is mostly rocky or sandy, that salt is present in the soil not only along the sea-shore and in the vicinity of the Great Rann, but more or less all over the country, we shall find it quite natural that most of the plants of Cutch exhibit a remarkable general similarity and agree in giving a lower rate of transpiration than plants living in places where plenty of water is available; in short that the vegetation shows a distinct xerophytic character. Nearly all the structural features by which transpiration is reduced may be observed in the Flora of Cutch; a thick cuticle upon the epidermis of the leaves, reduction of the number of stomata, depression of the stomata, a

thick covering of hairs, reduction of the transpiring surface, formation of aqueous tissue, etc.

CHAPTER XXIX

ODORIFEROUS GRASSES OF INDIA

1. *Andropogon Nardus*, Linn. This is a magnificent tall grass. The whole plant is sweet scented and grows wild in Ceylon. It is cultivated near Galle and other parts of the island, and also in Singapore, for its oil known as Citronella oil.

2. *Andropogon Khasianus*, Munro. Closely resembles the former.

3. *Andropogon distans*, Nees. Considered to be a variety of *Nardus*.

4. *Andropogon citratus*, D. C. Sold as "Green Tea". Yields Lemon Grass Oil or the oil of Verbena of Commerce. In India it is extensively cultivated in fields and gardens.

5. *Andropogon Schoenanthus*, Linn. Known to Europeans as "Ginger Grass" and to the people of this country as "Rosha". It is the best known of the scented grasses of the country. It is found growing wild all over India, Ceylon, Makao and Africa. In the Bombay Presidency it is common all over. Its high culms are seen by the road-side in Poona and Mahabaleshwar, especially on approaches to Panchgani. In Khandesh an oil called Rosh Oil is distilled from it.

6. *Andropogon versicolor*, Nees. It grows in Ceylon, Nilgiris, Africa and Mauritius.

7. *Andropogon Laniger*, Desf. This is a small beautiful slender grass known as "Woolly Andropogon", common in arid tracts of Africa and Asia. It is common in Baroda, Sindh and other dry tracts.

8. *Andropogon Iwarabcusa*, Roxb. A tall grass with erect culms, 2 to 6 feet high and long linear interrupted panicles, consisting of numerous flowering branches. It grows near the foot of the Himalayas, Hardwar, Neol, Karachi; also in various parts of Africa. The whole plant, roots, leaves and inflorescence is aromatic.

The following four species are described by Munro Thwaites, Haminton* etc.

(1) *Andropogon commutatus*, grown in Sind and Abyssinia.

(2) *Andropogon Gidarbo*, found in Monghyr. Both are noted for teribenthine acrid odour and taste.

Andropogon Hookerii, Munro. Is allied to *A. coccutatus*, and supposed to grow in Bhutan.

Andropogon lividus, Thur. Found in Ootacamund and Ceylon. Both these grasses are sweet scented, but the odour is slight and weak.

9. *Andropogon squarrosus*, Linn. This grows all over India, especially in warm places. In this Presidency, it is cultivated, and is also found wild in all Provinces. The plant is called "Wala" and its fragrant roots named "Khus-khus" are well-known throughout India, and used for making Tattis, fans, etc. It was formerly used for thatching bungalows in the Deccan and U. P.

10. *Andropogon pertusus*, Willd. This grass has a wide range, being found all over India, Afghanistan, Ceylon, Mauritius, Timor, Java, Africa and even in some parts of Italy. It is very common in Poona at the end of the rains, when it is very conspicuous by its beautiful purple panicle, consisting of four to six, in some cases even ten spikes, congested at the end of a long peduncle. Its vernacular name is "Payen" "Gania-Marvel."

11. *Andropogon citratus*. A tall grass with beautiful purple coloured inflorescence, growing in various parts of this Presidency. It is very common in Lonavla.

12. *Andropogon intermedius*, "Almost devoid of odour."

13. *Andropogon Ischemum* Linn. It grows in Europe, Asia Minor, Africa, Afghanistan, China, Northern India, Rawalpindi, The Punjab, Jeypore, Rajputana, Aligarh, and Allahabad.

14. *Andropogon micranthus*, Kunth. It is found in various parts of India. It is also grown in Australia, China, Japan, Phillipine Islands and Abyssinia. It is faintly odorous.

15. *Andropogon villosus*, Steud. It is found in Nepal, the Khasia mountains from 1,800 to 2,000 feet. Also in Kumaon, Rajputana and China.

16. *Andropogon Hugelli*, Hack. Var. *foetidus*, Hack. Local name "Podan", "Padra". Common all over the Presidency, especially in Thana, Bassein, and over the Ghats. Used as fodder. No oil is extracted. The inflorescence is scented, the odour being soft and very pleasant. "Delicately scented". Dhutic.

CHAPTER XXX

THE FLORA OF SIND

Ranunculaceae.	<i>Ranunculus scleratus</i> L.
Menispermaceae.	<i>Cocculus Loeba</i> D.C.
Nymphaeaceae.	<i>Nymphaea lotus</i> L.S.
Papaveraceae.	<i>Argemone mexicana</i> L.
Fumariaceae.	<i>Fumaria parviflora</i> Lam.
Cruciferae.	<i>Nasturtium officinale</i> R.Br.

- Farsetia Jacquemontii* Hook.
Farsetia Hamiltoni Royle.
Moricandra tortuosa H.F.
Senebiera pinnatifida D.C.
Thiaspi arvens L.
Physorhynchus brahuicus Hook.
Brassica sp.
- Capparidaceae.** *Cleome papillosa* Steud.
Cleome quinquenervia D.C.
Cleome brachycarpa Vahl.
Cleome burmanni Wt. & Arn.
Cleome viscosa L.
Gynandropsis pentaphylla D.C.
Dipterygium glaucum Decne.
Cadaba farinosa Forsk.
Cadaba heterotricha Stocks.
Capparis spinosa L.
Capparis decidua Pab.
Capparis horrida L.F.
- Resedaceae.** *Reseda pruinosa* Delile.
Reseda aucheri Boiss.
Ochradenus baccatus Delile.
- Violaceae.** *Viola Stocksii* Boiss.
- Polygalaceae.** *Polygala erioptera* D.C.
- Caryophyllaceae.** *Spergularia arvensis* L.
Polycarpaea spicata Wt. and Arn.
- Portulacaceae.** *Portulaca oleracea* L.
Portulaca quadrifida L. Mant.
Portulaca tuberosa Roxb.
- Tamaricaceae.** *Tamarix gallica* L.
Tamarix dioica Roxb.
Tamarix articulata Vahl.

- Tamarix ericoides* Rottl.
Tamarix stricta Boiss.
- Elatinaceae.** *Bergia odorata* Edgew.
Bergia ammanoides Roxb.
- Malvaceae.** *Althea Ludwigi* L. Mantiss.
Malva rotundifolia L.
Malva parviflora L.
Sida veronicifolia Lam.
Sida spinosa L.
Sida grewioides Guill.
Abutilon indicum Sweet.
Abutilon muticum Sw.
Abutilon graveolens Wt. et Arn.
Abutilon ramosum Guill.
Abutilon cornutum T. Cook.
Pavonia arabica Steud.
Pavonia zeylanica Cav.
Pavonia ceratocarpa Mast.
Pavonia propinqua Garcke.
Senra incana Cav.
Hibiscus trionum L.
Hibiscus micranthus L.
Hibiscus indicus Stocks.
Hibiscus cannabinus L.
Hibiscus punctatus Dalz.
Thespesia populnea Soland.
Gossypium Stocksii Mast.
Gossypium arboreum L.
Bombax Malabaricum Dc.
- Sterculiaceae.** *Melhania abyssinica* A. Rich.
Melhania tomentosa Stocks.
Melhania Denhami R.Br.

Tiliaceae.

Grewia populifolia Vahl.
Grewia salvifolia Heyne ex Roth.
Grewia asiatica L. Mantiss.
Grewia villosa Willd.
Corchorus olitorius L.
Corchorus trilocularis L. Mant.
Corchorus Antichorus Raeasch.
Corchorus tridens L. Mant.
Corchorus acutangulus Lam.

Zygophyllaceae.

Tribulus terrestris L. Sp.
Tribulus alatus Del.
Seetzenia orientalis Dene.
Peganum Harmala L.
Zygophyllum simplex L.
Zygophyllum coccineum L.
Fagonia cretica L.

Geraniaceae.

Monsonia senegalensis Guill & Perr.
Monsonia heliotropioides Boiss.
Erodium cicutarium L' Herit ex Ait.

Rutaceae.

Ruta tuberculata Forsk.
Citrus aurantium L.
Aegle Marmelos Corr.

Simarubaceae.

Ailanthus excelsa Roxb.
Garuga pinnata Roxb.
Commiphora Mukul Engle. in D.C
Commiphora Stocksiana Engl.

Meliaceae.

Azadirachta indica A. Juss.

Celastraceae.

Gymnosporia montana Benth.

Rhamnaceae.

Zizyphus Jujuba Lam.
Zizyphus trinervia Roxb.
Ziphyphus rotundifolia Lam.
Zizyphus horrida Roth.

Vitaceae.	<i>Zizyphus rugosa</i> Lamk.
	<i>Vitis vinifera</i> L.
Sapindaceae.	<i>Cardiospermum halicacabum</i> L.
	<i>Dodonea viscosa</i> L.
Anacardiaceae.	<i>Rhus mysurensis</i> Heyne.
	<i>Mangifera indica</i> L.
Moringaceae.	<i>Moringa pterigosperma</i> Gaertn.
	<i>Moringa Concanensis</i> Nimmo.
Papilionaceae.	<i>Argyrolobium roseum</i> Jaub & Spach.
	<i>Lotononis Leobordea</i> Benth.
	<i>Heylandia latebrosa</i> Dc.
	<i>Crotalaria Burhia</i> Hamilt.
	<i>Crotalaria medicaginea</i> Lamk.
	<i>C. var. neglecta</i> Baker.
	<i>Crotalaria juncea</i> L.
	<i>Trigonella oculata</i> Delile.
	<i>Melilotus indica</i> All.
	<i>Medicago lupulina</i> L.
	<i>Medicago laciniata</i> All.
	<i>Medicago denticulata</i> All.
	<i>Lotus corniculata. var. minor</i> Baker.
	<i>Lotus Garcini</i> D.C.
	<i>Cyamopsis psoraliodes</i> D.C.
	<i>Indigofera linifolia</i> Retz.
	<i>Indigofera cordifolia</i> Heyne.
	<i>Indigofera trigonelloides</i> Jaub & Spach.
	<i>Indigofera anabaptista</i> Steud.
	<i>Indigofera paucifolia</i> Del.
	<i>Indigofera articulata</i> Goiiian.
	<i>Indigofera tenuifolia</i> Rottl.
	<i>Indigofera viscosa</i> Lamk.
	<i>Indigofera argentea</i> Burm.
	<i>Indigofera Houer</i> Forsk.

Indigofera tinctoria L.
Psorelia plicata Delile.
Tephrosia tenuis. Wall.
Tephrosia coccinea Wall.
Tephrosia Apollinea Link.
Tephrosia paucifolia Grah in Wall
Tephrosia petrosa Blatt & Hall.
Sesbania aculeata Poir.
Astragalus prolixus Sieb.
Astragalus contortuplicatus L.
Astragalus Stocksii Benth.
Taverneria nummularia DC.
Alhagi camelorum Fisch.
Smithia bigemina Dalz.
Alysicarpus monilifer DC.
Alysicarpus vaginalis DC.
Alysicarpus rugosus DC.
Alysicarpus tetragonolobus Edgew.
Lathyrus inconspicus L.
Erythrina indica Lam.
Butea frondosa Konig ex Roxb.
Phaseolus semierectus L. Mantiss.
Phaseolus trilobus Ait.
Phaseolus radiatus L. Sp.
Phaseolus aconitifolius Jacq.
Vigna Catjang Walp.
Rhynchosia minima DC.
Rhynchosia rhombifolia Blatt and Hall.
Rhynchosia arenaria Blatt & Hall.
Dalbergia sissoo Roxb.
Pongamia glabra Vent.
Cajanus indicus Spreng.

Caesalpinae.

Caesalpinia Bonducella Flemming.

Poinciana regia Bojer.

Parkinsonia aculeata L.

Cassia fistula L.

Cassia occidentalis L.

Cassia Sophora L.

Cassia Tora L.

Cassia auriculata L.

Cassia obovata Collad.

Cassia holosericea Fresen.

Cassia angustifolia Vahl.

Tamarindus indicus L.

Bauhinia Sp.

Prosopis specigera L. Mant.

Mimosa rubicaulis Lamk.

Mimosa hamata Willd.

Acacia arabica Willd.

Acacia Farnesiana Willd.

Acacia eburnea Willd.

Acacia Jacquemonti Benth.

Acacia Senegal Willd.

Albizzia Lebbek Benth.

Albizzia procera Benth.

Pithecolobium dulce Benth.

Rosaceae.

Potentilla supina L.

Neurada procumbens L.

Saxifragaceae.

Vahlia viscosa Roxb.

Rhizophoraceae.

Ceriops Candolleana Arn.

Combretaceae.

Terminalia tomentosa Wt & Arn.

Myrtaceae.

Psidium Guyava L.

Eugenia Jambolana Lam.

Myrtus communis L.

Eucalyptus sp.

Lythraceae.

Ammania baccifera L.
Ammania multiflora.
Ammania salicifolia Mont.
Ammania desertorum Blatt & Hall.
Lowsonia enermis L.
Lagerstroemia indica L.

Cucurbitaceae.

Momordica Charantia L.
Momordica Balsamina L.
Luffa echinata Roxb.
Cucumis trigonus Roxb.
Cucumis Melo L.
Cucumis prophetarum L. Cent.
Citrulus Colocynthus Schrad.
Coccinia indica Wt & Arn.
Melothria madaraspata Cogn.
Gisekia pharnacoides L.
Limeum indicum Stocks.

Umbelliferae.

Hydrocotyle javanica Thumb.
Zosimia orientalis Hoffm.

Rubiaceae.

Mitragyna parviflora Korth.
Oldenlandia retrorsa Boiss.

Compositae.

Vernonia cinera Less.
Vernonia cinerascens Schultz.
Grangea maderaspatena Poir.
Laggera auruta Schultz.
Pluchia tomentosa DC.
Pluchia Wallichiana DC.
Pluchia lanceolata C.B.
Pluchia arguta Boiss.
Lasiopogon lanatum Cass.
Gnaphallium luteo-album L.
Gnaphallium indicum L.
Gnaphallium pulvinatum Del.

- Inula grantioides* Boiss.
Pulicaria angustifolia DC.
Pulicaria foliosa DC.
Pulicaria glaucescens Jaub.
Pulicaria Boissieri Hook.
Pulicaria Stocksii Hook.
Xanthium strumarium L.
Eclipta erecta L. Mantiss.
Blainvillea rhomboidea Cass.
Artimisia scoparia Waldst & Kit
Echinops echinatus DC.
Volutarella divaricata Benth & Hook.
Dicoma tomentosa. Cass.
Hochstetteria Schimperii DC.
Lactuca remotiflora DC.
Sonchus oleracens L.
Sonchus asper Hill.
Launea nudicaulis Hook.
Launea chondrilloides Hook.
Launea glomerata Hook.
- Goodeniaceae.** *Scaevola Koenigii* Vahl.
Scaevola Lobelia Murr.
- Plumbaginaceae.** *Statice Stocksii* Bois.
- Myrsinae.** *Aegiceras majus* Gaertn.
- Oleaceae.** *Jasminum Sambac* Ait.
- Salvadoraceae.** *Salvadora persica* L.
Salvadora oleoides Dene.
- Apocynaceae.** *Rhizya stricta* Dene.
Nerium odorum Soland.
- Asclepiadaceae.** *Periploca aphylla* Dnce.
Glossonema varians Benth.
Calotropis procera R. Br in Ait.

Gentianaceae.

Boraginaceae.

Oxystelma esculentum R. Br.
Pentatropis cynanchoides R. Br.
Daemia cordata R. Br.
Sarcostemma brevistigma Wt.
Sarcostemma Stocksii Hook.
Leptadenia spartium Wt.
Caralluma edulis Benth.
Enicostemma littorale Blume.
Cordia myxa L.
Cordia Rothii Roem & Schult.
Ehretia aspera Roxb.
Coldenia procumbens L.
Heliotropium zeylanicum Lam.
Heliotropium ophioglossum Stocks.
Heliotropium supinum L.
Heliotropium rariflorum Stocks.
Heliotropium Eichwaldi Steud.
Heliotropium calcareum Stocks.
Heliotropium tuberculosum Boiss.
Heliotropium undulatum Vahl.
Heliotropium paniculatum R. BR.
Trichodesma africanum R. Br.
Sericostoma pauciflorum Stocks.
Arnebia hispidissima DC.

Convolvulaceae.

Cuscuta hyalina Roth.
Cressa cretica L.
Evolvulus alsinoides L.
Breweria latifolia Benth.
Convolvulus sindicus. Stocks.
Convolvulus Rotterlianus Choisy.
Convolvulus microphyllus Sieb.
Convolvulus rhyniospermus Hochst.
Convolvulus glomeratus Choisy.

Convolvulus arvensis L.
Merremia chrysedes Hallier.
Merremia dissecta Hallier.
Ipomoea eriocarpa R. Br.
Ipomoea sindica Stapf.
Ipomoea rumicifolia Choisy.
Ipomoea pilosa Sweet.
Ipomoea aquatica Forks.
Ipomoea biloba Forsk.
Ipomoea palmata Forsk.
Rivea hypocrateriformis Choisy.

Solanaceae.

Solanum nigrum L.
Solanum xanthocarpum Schrad & Wend.
Solanum incanum L.
Solanum albicaule Kotschy ex Dunale.
Solanum gracilipes Dene.
Solanum Melongena L.
Physalis minima L.
Withania somnifera Dunal.
Withania coagulans Dunal.
Lycium barbatum L.
Datura fastuosa L.
Datura fastuosa var *alba*. C.B.
Hyoscyamus muticus L. Mant.
Nicotiana tabacum L.

Scrophulariaceae.

Antichris glandulosa Aschers.
Antichris linearis Hochst.
Celsia coromandeliana Vahl.
Linaria ramosissima Wall.
Linaria cabulica Benth.
Schweinfurthia sphaerocarpa A. Braun.
S. pedicellata Benth and Hook.
Moneira cuneifolia Michaux.

Orobanchaceae.

Bignoniaceae.

Pedaliaceae.

Acanthaceae.

Verbenaceae.

Labiatae.

Peplidium humifusum Delile.
Campylanthus ramosissimus Wt.
Striga lutea Lour.
Lindenbergia abyssinica Hoch.
Cistanche tubulosa Wt.
Tecomella undulata Seem.
Sesamum indicum L.
Blepharis sindica T. Anders.
Hygrophylla polysperma T. Anders.
Ruellia patula Jacq.
Ruellia longifolia T. Anders.
Hemigraphis dura T. Anders.
Barleria Prionitis L.
B. acanthoides Vahl.
Barleria Hochstetteri Nees.
Lepidaghatia rigida Dalz.
Lepidaghatia calycina Hochst.
Dicliptera micranthes Nees.
Justicia heterocarpa T. Anders.
Justicia diffusa Willd.
Justicia simplex D. Don.
Peristrophe bicalyculata Nees.
Lantana Camara L.
Lippia nodiflora Michaux.
Bouchia marrubifolia Schauer.
Priva leptostachya Juss.
Tectona grandis L.
Gmelina arborea Roxb.
Vitex negundo L.
Clerodendron Phlomoides L.
Ocimum canum Sims.
Leucas urticifolia R. Br.

- Leucas nutans* R. Br.
Salvia plebeia R. Br.
Salvia Aegyptiaca L.
 also var. *pumila*.
- Plantaginaceae.** *Plantago Stocksii* Boiss.
Plantago amplexicaulis Cav.
Plantago ovata Forsk.
Plantago ciliata Desf.
- Nyctaginaceae.** *Boerhaavia diffusa* L.
Boerhaavia verticillata Pair.
Boerhaavia elegans Choisy.
- Illecebraceae.** *Cometes surattensis* Burm.
- Amarantaceae.** *Celosia argenta* L.
Digera arvensis Forsk.
Amarantus gangeticus L.
Amarantus viridis L.
Amarantus polygamus L.
Aerua tomentosa Forsk.
Aerua pseudo-tomentosa Blatt and Hall.
Nothosaerua brachiata Wt.
Achyranthes aspera L.
Pupalia lappasea Moq. in D.C.
Alternanthera triandra Lam.
- Chenopodiaceae.** *Chenopodium album* L.
Atriplex Stocksii Boiss.
Arthrocnemum indicum Moq.
Sueda fruticosa Forsk.
Sueda nudiflora Moq.
Sueda monoica Forsk.
Sueda maritima Dumort.
Holoxylon recurvum Bunge.
Holoxylon salicornicum Bunge.
Salsola foetida Del.

Polygonaceae.

Calligonum polygonoides L.
Pteropryum Oliverii Jaub and Spach.
Polygonum salicornioides Jaub and Spach.
Polygonum plebejum R. Br.
Polygonum glabrum Willd.
Rumex dentatus L. Manis.

Aristolochiaceae.

Aristolochia bracteata Retz.

Euphorbiaceae.

Euphorbia nerifolia L.
Euphorbia dracunculoides Lamk.
Euphorbia hypericifolia L.
Euphorbia hirta L.
Euphorbia thymifolia L.
Euphorbia granulata Forsk.
Euphorbia Clarkana Hook.
Euphorbia tirucalli L.
Andrachne aspera Spreng.
Fluggea microcarpa Blume.
Phyllanthus reticulatus Poir.
Phyllanthus Emblica L.
Phyllanthus maderaspatensis L.
Phyllanthus Niruri L.
Phyllanthus debilis Herb.
Chrozophora tinctoria A. Juss.
Chrozophora obliqua A. Juss.
Chrozophora prostrata Dalzell.
Mallotus phillippinensis Muell.
Ricinus communis L.

Urticaceae.

Forskohlea tenacissima L. Mant.
Ficus bengalensis H. Hort.
Ficus religiosa L.
Ficus Tsjakela Burm.

Salicaceae.

Populus euphratica Oliv.

- Gnetaceae. *Ephedra foliata* Boiss.
- Hydrocharitaceae. *Vallisneria spiralis* L.
Hydrilla verticillata Prest.
- Orchidaceae. *Zeuxine sulcata* Lindl.
- Liliaceae. *Asparagus dumosus* Baker.
Dipcadi erythraeum Webb & Berth.
- Palmaceae. *Phoenix dactylifera* L.
Nannorrhops Ritchieana Griff.
- Niadaceae. *Potamogeton perfoliatus* L.
Potamogeton pectinatus L.
Zannichellia palustris L.
- Cyperaceae. *Cyperus arenarius* Retz.
Cyperus tegetum Roxb.
Cyperus rotundus L.
Fibristylis dichotoma Vahl.
Fibristylis ferruginea Vahl.
Eleocharis capitata R. Br.
Scirpus quinquefarius Ham.
Scirpus maritimus L.
Scirpus littoralis Schrad.
- Graminae. *Pennesetum Alopecurus* Nees.
Pennesetum dichotomus Del.
Pennesetum setosum Rich.
Pennesetum senchroides Rich.
Pennesetum Typhoideum Rich.
Cenchrus biflorus Roxb.
Setaria verticillata Beauv.
Tricholeana Teneriffae Parlat.
Panicum flavidum Retz.
Panicum fluitans Retz.
Panicum colonum L.
Panicum prostratum Lam.

Panicum ramosum L. Mantis.
Panicum interruptum Willd.
Panicum turgidum Forsk.
Panicum antidotale Retz.
Digitaria sanguinalis Scop.
Digitaria pinnata Hook.
Paspalum scrobiculatum L.
Eriochloa polystachya H.B. & K.
Imperata arundinacea Cyrill.
Saccharum spontaneum L. Mant.
Erianthus Ravennae Beauv.
Rottboellia compressa L.
Arthroxon lanceolatus Hoochst.
Elionurus Royleanus Nees.
Elionurus hirsutus Munro.
Andropogon Iwarancusa Jones.
Andropogon foveolatus Del.
Andropogon Aucheri Boiss.
Sorghum vulgare Pers.
Dicanthium annulatum Stapf.
Coix lachryma—Jobbi L.
Tristachya barbata Ness.
Phragmites Karka Trin.
Aristida Adscensionis L.
Aristida hirtigluma Steud.
Aristida hystriacula Edgew.
Aristida mutabilis Trin.
Aristida funiculata Trin.
Heliochloa schoenoides Host.
Heliochloa dura Boiss.
Tragus racemosa Scop.
Latipes senegalensis Kunth.
Sporobolus diander Beauv.

Sporobolus indicus Stapf.
Sporobolus ioclados Nees.
Sporobolus glaucifolius Hochst.
Sporobolus arabicus Boiss.
Sporobolus coromandelianus Link.
Eragrostis ciliaris Link.
Eragrostis plumosa Link.
Eragrostis interrupta Beauv.
Eragrostis major Host.
Eragrostis minor Host.
Eragrostis pilosa Beauv.
Desmostachya bipinnata Stapf.
Halopyrum mucronatum Stapf.
Gracilea Royeana Hook.
Cynodon dactylon Pers.
Chloris tennela Roxb.
Chloris villosa Pers.
Chloris barbata Sw.
Chloris quinquesetica Bhide.
Eleusine flagellifera Nees.
Eleusine egyptiaca Desf.
Eleusine aristata Ehrenb.
Enneapogon elegans T. Cook.
Oryza coarctata Roxb.
Aeluropus villosus Trin, ex. L.
Arundo Donax L.

CHAPTER XXXI

PLANTS OF THE INDIAN DESERT

Menispermaceae. *Cocculus cebatha* Dc.
 Farsetia macrantha Blatt and Hall.

- Capparidaceae.** *Cleome papillosa* Steud.
Cleome brachycarpa Vahl.
Cleome viscosa L.
Gynandropsis pentaphylla D.C.
Cadaba indica Lam.
Capparis decidua Pax.
- Violaceae.** *Viola Stocksii* Boiss.
- Polygalaceae.** *Polygala erioptera* D.C.
Polygala irregularis Boiss.
- Caryophyllaceae.** *Polycarpaea corymbosa* Lam.
- Portulacaceae.** *Portulaca oleracea* L.
Portulaca quadrifida L.
- Tamaricaceae.** *Tamarix dioica* Roxb.
Tamarix orientalis Forsk.
- Elatinaceae.** *Bergia ammanoides* Roxb.
Bergia odorata Edgew.
- Malvaceae.** *Sida grewoides* Guill
Abutilon fruticosum Guill.
Pavonia arabica Steud.
Hibiscus micranthus Lf.
Gossypium herbaceum L.
- Sterculiaceae.** *Melhania Denhamii* Br.
Melhania magnifolia Blatt and Hall.
- Tiliaceae.** *Grewia populifolia* Vahl.
Grewia villosa Willd.
Grewia abutilifolia Vent.
Corchorus trilocularis L.
Corchorus antichorus Raens.
Corchorus tridens L.
- Zygophyllaceae.** *Tribulus terrestris* L.
Tribulus alatus L.
Seetzenia orientalis Dene.

- Geraniaceae.
 Simarubaceae.
 Burseraceae.
 Celastraceae.
 Rhamnaceae.

 Sapindaceae.
 Moringaceae.

 Papilionaceae.

 Caesalpinae.
 Mimosae.
 Rosaceae.
 Lythraceae.
- Zygophyllum simplex L.
 Fagonia cretica L.
 Monsonia heliotropioides Bois.
 Balanites Roxburghii Planch.
 Commiphora Mukul Engl.
 Gymnosporia montana Benth.
 Zizyphus jujuba Lam.
 Zizyphus trinervia Roxb.
 Zizyphus rotundifolia Lam.
 Zizyphus truncata Blatt and Hall.
 Cardiospermum Halicacabum L.
 Moringa pterigosperma Gaert.
 Moringa concanensis Nimmo.
 Heylandia latebrosa D.C.
 Crotalaria Burhia Ham.
 Crotalaria Medicaginea Lam.
 Indigofera linifolia Retz.
 Indigofera cordifolia Heyne.
 Indigofera paucifolia Del.
 Indigofera argentea Burm.
 Indigofera anabaptista Steud.
 Tephrosia multiflora Blatt & Hall.
 Tephrosia incana Grah.
 Psoralea odorata Blatt and Hall.
 Alysicarpus vaginalis D.C.
 Phaseolus trilobus Ait.
 Rhynchosia arenaria Blatt and Hall.
 Rhynchosia rhombifolia Ball and Hall.
 Cassia obovata Collad.
 Acasia Senegal Willd.
 Neurada procumbens L.
 Ammania baccifera L.
 Ammania desertorum Blatt & Hall.

Onagraceae.

Cucurbitaceae.

Ficoidae.

Compositae.

Salvadoraceae.

Asclepiadaceae.

Gentianaceae.

Boraginaceae.

Trapa bispinosa Roxb.

Momordica dioica Roxb.

Cucumis Melo L.

Citrullus Colocynthis Schrad.

Melothria maderaspatana Cogn.

Trianthema triquetra Rottl & Willd.

Trianthema pentandra L.

Orygia decumbens Forsk.

Mollugo hirta Thunb.

Mollugo nudicaulis Lam.

Mollugo Cerviana Ser.

Gisekia pharnaceoides L.

Limeum indicum Stocks.

Vernonia cinerascens Schult.

Pegolettia senegalensis Cass.

Pulicaria angustifolia D.C.

Pulicaria rajputanae Blatt & Hall.

Eclipta erecta L.

Echinops echinatus R.

Volutarella divaricata Bth.

Dicoma tomentosa Cass.

Launea chondrilloides Hf.

Salvadora persica L.

Salvadora oleoides Dene.

Glossonema varians Benth.

Calotropis procera Br.

Pentatropis cynanchoides Br.

Sarcostemma brevistigma Wt.

Leptadenia spartium Wt.

Enicostemma littorale Bl.

Ehretia aspera R.

Heliotropium supinum L.

Heliotropium rariflorum Stks.

- Heliotropium undulatum*, Woodr.
Heliotropium paniculatum L.
Trichodesma indicum Br.
Sericostoma pauciflorum Stks.
Arnebia hispidissima D.C.
- Convolvulaceae.** *Cressa cretica* L.
Breweria latifolia Bth.
Convolvulus microphyllus Seib.
Convolvulus glomeratus Chois.
Ipomoea indica Stapf.
- Solanaceae.** *Solanum incanum* L.
Solanum albicaule Kotsch.
Lycium barbatum L.
- Scrophulariaceae.** *Anticharis linearis* Hochst.
Schweinfurthia sphaerocarpa Braun.
- Acanthaceae.** *Blepharis indica* T. Anders.
Ruellia patula Jacq.
Barleria hochstetteri Nees.
Justicia simplex.
- Verbenaceae.** *Bauchia marrubifolia* Schauer.
Clerodendron phlomoides Lf.
- Labiatae.** *Salvia aegyptiaca* L.
- Nyctaginaceae.** *Boerhaavia diffusa* L.
Boerhaavia verticillata Poir.
Boerhaavia elegans Chois.
- Amarantaceae.** *Aerua tomentosa* Forsk.
Aerua pseudo-tomentosa Blatt & Hall.
Achyranthes aspera L.
Pupalia lappacea Moq.
- Chenopodiaceae.** *Haloxylon recurvum* Bunge.
Haloxylon salicornicum Bunge.
Salsola foetida Del.

Polygonaceae.	Calligonum polygonoides L.
	Polygonum plebejum Br.
Aristolochiaceae.	Aristolochia bracteata Retz.
Euphorbiaceae.	Euphorbia granulata Forsk.
	Phyllanthus niruri L.
Liliaceae.	Asparagus racemosus Willd.
Commelinaceae.	Commelina albescens Haask.
Cyperaceae.	Cyperus niveus Retz.
	Cyperus arenarius Retz.
	Cyperus conglomeratus Rottb.
	Cyperus rotundus L.
	Fimbristylis tenera Boeck.
	Scirpus quinquefarius Hann.
	Scirpus maritimus L.
Graminae.	Digitaria sanguinalia Scop.
	Panicum antidotale Retz.
	Panicum turgidum Forsk.
	Cenchrus catharticus Del.
	Latipes senegalensis Kunth.
	Elionurus Royleanus Nees.
	Elionurus hirsutus Mun.
	Andropogon foveolatus Del.
	Andropogon annulatus Forsk.
	Aristida funiculata Rupr.
	Aristida hirtigluma Steud.
	Gracilea Royleana H.f.
	Chloris villosa Pers.
	Eleusine flagellifera Nees.
	Eleusine aristata Ehrenb.
	Pappophorum elegans Nees.
	Eragrostis interrupta Beauv.
	Eragrostis pilosa Beauv.

Desmostachya bispinata Stapf.
(*Eragrostis cynosuroides* Beauv.)

Filicinae.

Actinopteria dichotoma Bedd.

GENERAL AND PHYSICAL ASPECTS OF THE INDIAN DESERT

The general barrenness of the country, the dry practically rainless climate and the scorching heat of the sun, not to omit the general susceptibility to the wind, have so modified the external organs of the desert plants, that it is but natural to conclude that the internal structure and the processes that are going on in the plants in like way have been acted upon by these external factors.

Physical Aspects

(a) **Topography:** The portion of the Great Indian Desert, under consideration, is included in the two States Jodhpur and Jaisalmer and forms a square having the four towns Jodhpur, Bap, Jaisalmer and Balmer at its four angles. The general aspect is that of a succession of dry undulating plains and rolling sand-dunes of all sizes and shapes varying from 2 to 3 miles in length and 20 to 400 feet in height. It is sparingly dotted with low bushes and isolated tufts of curious-looking plants, relieved here and there by green succulents and candalabra-like *Euphorbias*. Shifting sands are common and continually changing in size and shape. Villages are few and far between and consists of a few huts located round a well or a tank.

(b) **Geology:** The region under survey is covered for the most part with wind-blown sand-dunes which are of the transverse type, i.e. have their longer axes at right angles to the direction of the prevailing winds. From beneath these, rocks of earlier age crop out as isolated hills. Near Jodhpur the

oldest rocks are schists belonging to the Aravalli system. These are overlain by rocks of volcanic origin, the Mallani series, with conglomerate at the base. Upon these, rest sand-stones of the Vindyan age. At Balmer the rocks consist of sand-stones, grit and conglomerates containing ill-defined fossil remains. At Jaisalmer sand-stones and lime-stones of Jurassic age occur and Nummulitic rocks are common.

(c) **Meteriological Data:**

Temperatures: The normal maximum is 105.7 in June and 76.1 in January. The normal minimum is 82.7 in June and 45.1 in January.

Relative Humidity is 70.1 in August and 38.1 in November.

Rainfall: It is 2.17 to 4.21 in July and .11 in January.

Rainy Days: 5.2 in July and .1 in April.

CHAPTER XXXII

EPIPHYTES, SAPROPHYTES AND COMMENSALS

Epiphytes: Epiphytes are plants which perch upon the stem or branches of other plants, but are not parasitic upon them. They usually develop two sets of roots. One set which may be called "Climbing or Clinging Roots" which fix the plant firmly to the substratum and also obtain some nourishment. The other set may be called "Condensing Roots". These are often arranged in the form of a spray or are hanging freely and condense water vapour from the atmosphere to supplement the precarious water supply.

Epiphytes are usually not attached to the soil. In the Temperate Zone, they are to be seen only among Algae, Lichens, Liverworts and Mosses. In the Wet Forest regions of

the Tropics they are abundant. (Orchids and Ferns.) They perch upon the branches and even leaves of other trees. In fact, this is a marked feature of Tropical Vegetation. They are usually small in size, obtaining favourable situations without expenditure on large stems. The obtaining of food and water become more difficult, but most of them are well provided with adaptations for the peculiar position.

Among the classes and orders which possess epiphytes we may mention Ferns, many Bromeliaceae, Orchidaceae and Aroidae and the genus *Ficus* among the Urticaceae.

The following is a small list of plants from the Tropics outside Bombay Presidency which are typically epiphytic.

Guttiferae.	<i>Clusia.</i>
Cactaceae.	<i>Phyllocactus.</i>
	<i>Rhipsalis.</i>
Gesneraceae.	<i>Columnnea.</i>
	<i>Aeschenanthus.</i>
Asclepiadaceae.	<i>Dischidia.</i>
Rubiaceae.	<i>Hydnophytum.</i>
	<i>Myrmecodia.</i>

The following are genera and species found in the Bombay Presidency.

Gesneriaceae.	<i>Aeschenanthus Perottitii</i> , A. D.C.
Aroidaceae.	<i>Pothos scandens</i> Linn.
Urticaceae.	<i>Ficus Rhumphii</i> , Blume.
	var. <i>parasitica</i> .
	<i>Ficus gibbosa</i> Blume.
	<i>Ficus religiosa</i> , Linn.
	<i>Ficus scandens</i> , Roxb.
	<i>Ficus elastica</i> , Roxb.
Orchidaceae.	<i>Oberonia Falconeri</i> , Hook.
	<i>O. recurva</i> , Lindle.

O. Brunoniana, Wight.
Dendrobium all species.
Cirrhopetalum fimbriatum, Linn.
Bulbophyllum neilgherense, Wight.
Trias Stocksii, Hook.
Pholidota imbricata, Lindl.
Josephia lanceolata, Wight.
Porpax reticulata, Lindle.
Porpax Lichenora, T. Cook.
Eria all species.
Thunia venosa, Rolfe.
Cymbidium aloefolium, Swartz.
Sarcochilus all species.
Rhynchostylis all species.
Ærides all species.
Lucia teretifolia, Gaud.
L. tenuifolia, Blume.
Cottonia macrostychys, Wight.
Vanda parviflora, Lindle.
V. Roxburghii, R. Br.
Diplocentrum congestum, Wight.
Acampe Wightiana, Lindle.
Sarcanthus peduncularis, Dalz.

The following characters of epiphytes may be noted:—

1. A powerful seed-dispersal mechanism, either by wind or by birds.
2. A capacity to fasten themselves after germination, by means of roots which are always adventitious. No wonder that Monocotyledons form so large a proportion of the epiphytic flora.
3. They are situated in such places that their water supply is precarious and what water is available easily runs away.

They therefore possess excellent water storage arrangements.

4. They obtain their mineral requirements from decaying organic matter. (Humus).

5. Moisture is an important factor in regulating the distribution of epiphytes. Epiphytes with very pronounced xerophyly are seen on the very tops of trees, others with less marked characters are much lower down.

It may be taken as a general rule that epiphytes are characterized by a highly specialized development of:—

- (i) Organs of absorption.
- (ii) Structural peculiarities for effectively reducing transpiration.
- (iii) Organs of effective storage of water in comparatively large quantities.

Commensals: When two or more diverse organisms live together in intimate relationship, the phenomenon is termed Symbiosis, and the units so living together are called Symbionts. Symbiosis may be one of two kinds: (i) Social or (ii) Nutritive. In social symbiosis a number of plants of diverse families may live together under a set of external conditions with general benefit to all. This forms a plant community. In Nutritive symbiosis a definite set of two or more organisms live together, each giving some benefit to the other or the rest and itself benefiting by the proximity of the rest. This latter, therefore, is a case of Commensalism or Mesitism. It follows that true commensalism implies symbiosis in which two or more organisms live together with benefit to one another, but with injury to none. (When one injures the other, or lives partially or wholly at the expense of the other, the first is designated a Parasite and the other—from which it draws its nourishment—its "Host".)

Lichens are the best examples of the ideal Commensals. The Liverworts *Anthoceros* and *Blasia* and the water Fern *Azolla*, contain colonies of the Alga *Nostoc*. It is well known that *Palmetta* trees are inhabited by typical epiphytes and certain trees have characteristic Lichens growing on them. In heavy rainfall tracts along the Western Coast in India, and in the deeper forests of North and South Kanara, the enormous number of lichens on the trees therein is a striking feature, which cannot escape the notice of even the most casual observer.

When a plant is unable to grow in the soil which contains organic matter, and it is enabled to make use of the matter by the help of a "Fungus Servant", this peculiar kind of symbiosis (which implies the association of a fungus with the roots of a higher plant) is called a "Mycorrhiza". There is no doubt that a large number of flowering plants growing in Forests rich in humus are good examples of external "Mycorrhiza". There is little doubt that in this way the higher plant is supplied with soluble organic matter from the soil which it could not absorb in the ordinary way by means of root hairs. In some cases, as in *Monotropa*, the fungus threads which permeate the leaf mould form a dense matting on the surface of the roots. In others, as in *Neottia* these threads penetrate the roots and actually grow inside the living cells of the cortex.

Saprophytes: Saprophytes are generally defined as plants which obtain their food from decaying organic matter. Most Fungii, a few Mosses and a few flowering plants go to make up the sum total of saprophytes in the vegetable kingdom. The nitrifying organisms of soil and water, the organisms causing putrefaction of meat and the decomposition of milk and the bacteria of hay-infuions may be considered typically saprophytic. Among the Algae, some of the *Peridinae* and *Diatoms* are typical of these groups. There is no doubt that the

abundant growth of Algae in water-pipes and in drains is due to their great capacity for saprophytism.

Among the flowering plants, the genera *Neottia*, *Epipogon* and *Corallorhiza* among the Orchids, the *Triuridaceae*, *Burmanniaceae* and a few others are to a great extent saprophytes, though there is reason to believe that this opinion may have to be revised, in view of recent researches. It is known that there are various grades of saprophytism and parasitism among flowering plants, and the saprophytes slowly merge into the parasites. Total saprophytes are unable to grow in ordinary soil.

CHAPTER XXXIII

CLIMBING PLANTS

Climbing Plants or Lianas, as they are called, in modern terminology, are plants that ascend by climbing or leaning upon other plants or any adequate support they can obtain. The long internodes enable them to grow disproportionately long and their mechanical tissue is insufficient to permit them to stand erect. It does happen, however, as in the case of "Giant Climbers" that they later develop a great deal of this mechanical tissue and become very hard, woody and fibrous. Climbers are very characteristic of Tropical Forests and may be suitably divided into five principal groups:—

1. Twining Plants. 2. Climbers with sensitive organs.
3. Hook climbers. 4. Root climbers. 5. Leaners.

1. **Twining Plants:** In this group the growing tip of the main stem executes movements known as "Revolving Nutation", whereby the widening circumference comes within the sweep of the elongating stem.

2. **Tendrill Climbers:** This second group consists of plants that climb with the aid of tendrils. A tendril is a thin wiry structure extremely sensitive to contact. Its morphological value depends entirely upon its place and mode of origin. The tendril is usually a springlike structure, but may be simple or branched. These tendrils may sometimes be modified by contact into disc-shaped suckers that secrete a mucilaginous substance. In this way, they adhere most tenaciously to walls or the bark of trees. These "Adhesive Discs" are very highly developed in the Virginia Creeper (*Pseuderacanthus quinquefolia*). Morphologically, the tendril may be a leaf, leaflet, leaf-petiole, stem-tendril (in the axil of a leaf), a stipule or a leaf-tip. Examples of each kind are well-known.

3. **Hook Climbers:** The attachment or support is obtained by pressing the usual thorns or prickles into their service. Such are seen in Roses and Blackberries. Some of the hooks are directed backwards as in the Hop and are more efficient than the straight thorns, since they prevent them slipping backwards.

4. **Root-Climbers:** Here the roots, either normal or adventitious, take the place of "Climbing Organs". These may form, in extreme cases, adhesive discs and thus increase their efficiency greatly. Aroids, Bromeliaceae and most other Epiphytes exhibit remarkable growth of these "Climbing Roots" and these enable those plants to adhere firmly to the substratum. In many epiphytic Ferns we find the rhizomes themselves acting as "Adhesive Roots" penetrating successively the spongy bark and even applying themselves very closely to the stem, and rising higher with the growth of the plant.

5. **Leaners:** Leaners are those plants that lean on neighbouring plants. They have no specialized climbing organs, though occasionally they do show a tendency to develop twisting of the petiole or the main stem.

CHAPTER XXXIV

DROUGHT RESISTING PLANTS IN THE DECCAN

1. *Polygonum plebejum* R. Br.
2. *Chrozophora prostrata* Dalz.
3. *Solanum xanthocarpum* Schl.
4. *Argemone mexicana* L.
5. *Euphorbia nerifolia* Linn.
6. *Bombax malabaricum* D. C.
7. *Opuntia nigricans* Haw.
8. *Gymnosporia Rothiana* Laws.
9. *Fluggia leucopyrus* Willd.
10. *Lantana indica* Roxb.
11. *Vitis Woodrowii* Stapf.
12. *Acasia arbica* Willd.
13. *Lepidaghatia trinervis* Nees.
14. *Tephrosia purpurea* Pers.
15. *Zizyphus xylopyrus* Willd.
16. *Tragia cannabina* L.
17. *Echinops echinatus* Roxb.
18. *Leptadenia reticulata* W. & A.
19. *Cucumis trigonus* Roxb.
20. *Tridax procumbens* L.
21. *Vernonia cinerea* Lees.
22. *Cocculus villosus* D. C.
23. *Morinda tinctoria* Roxb.
24. *Caralluma fimbriata* Wall.
25. *Fagonia cretica* L.
26. *Heliotropium supinum* L.

27. *Alysicarpus rugosus*.
var. *styracifolius* Baker.
28. *Trichodesma indicum* Br.
29. *Celosia argentea* L.
30. *Heliotropium zeylanicum* Law.
31. *Taverniera nummularia* D. C.
32. *Citrullus colocynthis* Schrad.
33. *Balanites Roxburghii* Planch.
34. *Trianthema pentandra* L.
35. *Boerhaavia diffusa* L.
36. *Dipcadi montanum* Dalz.
37. *Cythocline lyrata* Cass.
38. *Andropogon monticola* Schultz.

Trees

- | | |
|---------------------------------|-----------------------------------|
| <i>Feronia elephantum</i> Corr. | <i>Diospyros melanoxylon</i> Rob. |
| <i>Ailanthus excelsa</i> Roxb. | <i>Salvadora oleoides</i> Dene. |
| <i>Melia Azadirachta</i> L. | <i>Ehretia aspera</i> R. |
| <i>Mangifera indica</i> L. | <i>Vitex Negundo</i> L. |
| <i>Butea frondosa</i> Konig. | <i>Euphorbia Tirucalli</i> L. |
| <i>Cassia fistula</i> L. | <i>Bridelia retusa</i> . Spr. |
| <i>Tamarindus indicus</i> L. | <i>Ficus bengalensis</i> L. |
| <i>Parkinsonia aculeata</i> L. | <i>Ficus retusa</i> . Linn. |
| <i>Acasia arabica</i> Willd. | <i>Phoenix sylvestre</i> R. |
| <i>Prosopis specigera</i> L. | |

Shrubs

- | | |
|-----------------------------------|-------------------------------------|
| <i>Capparis aphylla</i> Roth. | <i>Dichrostachys cineroa</i> W.&A. |
| <i>Capparis divaricata</i> Lam. | <i>Opuntia nigricana</i> Haw. |
| <i>Cadaba indica</i> Lam. | <i>Calotropis procera</i> Br. |
| <i>Gymnosporia Rothiana</i> Laws. | <i>Clerodendron Phlomoides</i> L.f. |
| <i>Rhus mysorensis</i> Heyne. | <i>Jatropha Curcas</i> L. |

Cassia auriculata L.
Mimosa hamata Willd.

Fluggea leucopyrus Dalz.
Agave vivipara Wight.

Climbing Plants.

Vitis pallida W. & A.
Gymnema sylvestra Br.

Cryptostegia grandiflora Br.
Rivea hypocrateriformis Chois.

Herbaceous Plants.

Cleome viscosa L.
Polygala erioptera D. C.
Triumfetta rotundifolia Lam.
Tribulus terrestris L.
Indigofera cordifolia Heyne.
Corchorus Antichorus Raen.
Blumea Malcolmi H.f.

Vicoa auriculata Cass.
Falveria contraverba Pers.
Evolvulus alsinoides.
Lippia nodiflora Michx.
Achyranthes aspera L.
Aerua javanica Juss.
Aristolochia bracteata Retz.

Grasses.

Pennesetum Alopecurus Nees.
Ischemum pilosum Hack.
Andropogon pertusus Willd.

Andropogon annulatus Forsk.
Cynodon dactylon Pers.

CHAPTER XXXV

WEEDS OF RICE FIELDS

An ecological study of the secondary formations in the Rice Fields at Alibag.

The weeds may be classed into two distinct groups.

1. The first group consisting of Hydrophytes and messophytic forms flowering from August to December.
2. The second group, less mesophytic and xerophytic, flowering from December to April.

FIRST GROUP

Lythraceae.	Ammania baccifera Linn.
Compositae.	Ageratum conyzoides Linn.
	Caesulia axillaris Roxb.
Verbenaceae.	Lippia nodiflora Rich.
Acanthaceae.	Hygrophylla spinosa T. Anders.
Graminaceae.	Panicum flavidum Retz.
	Panicum frumentaceum.
	Eleusine indica Gaertn.
	Diplachne fusca Beauv. (In salt marshes).
Cyperaceae.	Cyperus aristatus Rotb.
	Cyperus Iria Linn.
	Cyperus difformis Linn.
	Cyperus exaltatus Retz.
	Fimbristylis quinquangularis, kunth.

SECOND GROUP

Tilliaceae.	Corchorus fascicularis Lamk.
Papaveraceae.	Argemone Mexicana Linn.
Leguminosae.	Alysicarpus rugosus D.C.
Ficoidae.	Mollugo hirta Thumb.
Gentianaceae.	Canscora diffusa R. Br.
Rubiaceae.	Oldenlandia corymbosa Linn.
	Oldenlandia herbacea Roxb.
Compositae.	Sphaeranthus indicus Linn.
	Spilanthes Acmilla Linn.
	Ganphalium indicum Linn.
	Xanthium strumarium Linn.
Convolvulaceae.	Ipomea reniformis Chois.
	Cressa cretica Linn. (Salt Marshes).
	Evolvulus alsinoides Linn.

Elatinaceae.	<i>Bergia ammanoides</i> Benth.
Portulacaceae.	<i>Portulaca oleracea</i> .
Commelinaceae.	<i>Ancilima spiratum</i> R. Br.
Solanaceae.	<i>Solanum xanthocarpum</i> Schrad & Wendl.
Hydrophyllaceae.	<i>Hydrolea zeylanica</i> Vahl.
Acanthaceae.	<i>Hygrophylla Serpyllum</i> T. Anders. <i>Rungia parviflora</i> Nees.
Chenopodiaceae.	<i>Chenopodium album</i> Linn.
Onagraceae.	<i>Ludwigia parviflora</i> Roxb.
Lythraceae.	<i>Ammania baccifera</i> L. <i>Ammania tenuis</i> C. B. Clark.
Scrophulariaceae.	<i>Stemodia viscosa</i> Roxb. <i>Stemodia serrata</i> Benth.
Boraginaceae.	<i>Heliotropium ovalifolium</i> Forsk. <i>Heliotropium supinum</i> Linn.
Euphorbiaceae.	<i>Chrozophora plicata</i> A. Juss. <i>Euphorbia pilulifera</i> Linn. <i>Euphorbia thymifolia</i> Burm. <i>Euphorbia hypericifolia</i> Linn. <i>Euphorbia microphylla</i> Heyne. <i>Euphorbia coccinea</i> Roth. <i>Euphorbia zorhioides</i> Bois.
Amarantaceae.	<i>Amarantus Blitum</i> Linn. <i>Amarantus spinosus</i> Linn. <i>Amarantus polygonus</i> Linn.
Eriocaulaceae.	<i>Ericaulon</i> sp.
Graminaceae.	<i>Arundinella agrostoides</i> H.f. <i>Alytrophorus articulatus</i> Beauv.

In Rice Fields and Broad Bunds.

Compositae.	<i>Eclipta erecta</i> Hassk.
-------------	------------------------------

- Companulaceae.** *Sphenoclea zeylanica* Gaert. (In salt Marshes).
- Graminaceae.** *Eriochloa polystachya* H.B. & K.
 Isacne australis Br.
 Coix Lachrhyra Jobbi Linn.
 Eragrostis amabilis Wt.
 Ischemum aristatum L.
 sub-species *barbatus*.
 Andropogon odoratus Da & Lisb.
 Anthisteria ciliata, L.
- Leguminosae.** *Geisopsis cristata* W. & A. (On bunds only).
- Gentianaceae.** *Exacum pumilum* Gricab.
- Amarantaceae.** *Celosia argentea* Linn.

Weeds very resistant to drought.

Chrozophora plicata.
Heliotropium supinum.
Heliotropium ovalifolium.
Mollugo hirta.
Sphaeranthus indicus.
Solanum xanthocarpum.
Stemodia viscosa.
Stemodia serrata.
Hygrophylla Serpyllum.
Argemone Mexicana.
Xanthium strumarium.

The following show a beautiful tomentum or a rich pubescence on the stem and leaves characteristic of xerophytic forms:—

Gnaphalium indicum.
Chrozophora plicata.
Mollugo hirta.

Heliotropium ovalifolium.

Heliotropium supinum.

Evolvulus alsinoides.

Sphaeranthus indicus.

Xanthium strumarium.

Cressa cretica. (In fields near salt marshes).

Note: The following grasses are known to harbour the Rice stem borer *Schaenobius bipunctifer* (Wek) commonly known as Sheer in Marathi.

Ischemum aristatum.

sub. sp. *barbatum*.

Andropogon odoratus.

Anthisteria ciliata.

Agr. Coll. Mag. Vol. IX supplement page 1 to 16.

OUR UNWELCOME GUESTS

Some weeds of the Poona Agricultural College Farm

- | | |
|-------------------|---|
| 1. Papaveraceae. | <i>Argemone mexicana</i> . L. |
| 2. Capparidaceae. | <i>Cleome simplicifolia</i> . H.f. & T. |
| 3. Portulacaceae. | <i>Portulaca oleraceaea</i> . L. |
| 4. Malvaceae. | <i>Sida spinosa</i> . L. |
| 5. Tiliaceae. | <i>Corchorus olitorius</i> . L. |
| 6. Papilionaceae. | <i>Indigofera glandulosa</i> . Willd. |
| 7. Papilionaceae. | <i>Heylandia latebrosa</i> . D.C. |
| 8. Caesalpinae. | <i>Cassia Tora</i> . Ba. H. |
| 9. Rubiaceae. | <i>Anotis Monthononii</i> . Hk.f. |
| 10. Rubiaceae. | <i>Oldenlandia corymbosa</i> . L. |
| 11. Compositae. | <i>Vernonia cinerea</i> . Lees. |
| 12. Compositae. | <i>Pulicaria Wightiana</i> . D.C. |
| 13. Compositae. | <i>Caesulia axillaris</i> . R. |
| 14. Compositae. | <i>Lagasca Mollis</i> . Cav. |

- | | |
|--------------------|--|
| 15. Compositae. | <i>Eclipta erecta.</i> L. |
| 16. Compositae. | <i>Bidens pilosa.</i> L. |
| 17. Compositae. | <i>Tridax procumbens.</i> Linn. |
| 18. Compositae. | <i>Tricholepis radicans.</i> D.C. |
| 19. Compositae. | <i>Sonchus oleraceus.</i> L. |
| 20. Compositae. | <i>Ageratum conyzoides.</i> L. |
| 21. Labiatae. | <i>Ocimum sanctum.</i> L. |
| 22. Labiatae. | <i>Lavandula Burmanni.</i> Bth. |
| 23. Labiatae. | <i>Leucas longifolia.</i> Bth. |
| 24. Amarantaceae. | <i>Celosia argentea.</i> L. |
| 25. Amarantaceae. | <i>Amarantus polygamus.</i> L. |
| 26. Euphorbiaceae. | <i>Phyllanthus madaraspatisensis.</i> L. |
| 27. Euphorbiaceae. | <i>Acalypha malabarica.</i> Mucll. |
| 28. Cyperaceae. | <i>Cyperus rotundus.</i> L. |

This list omits the Grasses.

Agr. College Mag. Vol. VIII, pp. 133.

Some Farm Weeds of Sind

- | | |
|---------------------|---|
| 1. Graminaceae. | <i>Eragrostis cynosuroides</i> Beaum. |
| 2. Graminaceae. | <i>Elusine flagellifera.</i> Nees. |
| 3. Graminaceae. | <i>Cynodon dactylon.</i> Pers. |
| 4. Graminaceae. | <i>Panicum colonum.</i> Linn. |
| 5. Graminaceae. | <i>Eleusineegyptiaca.</i> Deaf. |
| 6. Graminaceae. | <i>Andropogon annualatus</i> Forsk. |
| 7. Cyperaceae. | <i>Cyperus rotundus.</i> L. |
| 8. Capparidaceae. | <i>Cleome viscosa.</i> L. |
| 9. Amarantaceae. | <i>Digera arvensis.</i> Forsk. |
| 10. Euphorbiaceae. | <i>Euphorbia hypericifolia.</i> L.
var. <i>parviflora.</i> |
| 11. Zygophyllaceae. | <i>Tribulus terrestris.</i> L. |

Agr. College Mag. Vol. VIII, pp. 179.

CHAPTER XXXV

FLORA OF THE INDUS DELTA AND THE SUNDRIBUNS

In order to get a more accurate insight into the relations of the two floras, and especially for the convenience of all those who feel inclined to tackle the innumerable botanical and biological problems that slumber in the waters and marshes of the two deltas, we subjoin a list of the indigenous plants that up to now have been discovered in the Indus Delta and the Sundribuns.

We add a column to the list which shows whether a species is a herb (H), an undershrub (U), a shrub (S) or a tree (T).

	Habit	Indus Delta	Sundri- buns
Ranunculaceae.			
Naravelia zeylanica DC.	.. S		*
Menispermaceae.			
Cocculus pendulus Diels.	.. S	*	
Tinospora malabarica Miers.	.. S		*
Nymphaeaceae.			
Nymhaea rubra Roxb.	.. H	*	
„ stellata Willd.	.. H	*	
Nelumbium speciosum Willd.	.. H	*	
Cruciferae.			
Farsetia Jacquemontii Hook. f.&Th.	.. H	*	
Senebiera pinnatifida DC.	.. H		*
Capparidaceae.			
Cleome brachycarpa Vahl	.. H	*	
„ viscosa Linn.	.. H	*	*

		Habit	Indus Delta	Sundri- buns
Gynandropsis pentaphylla D.C.	..	H	*	*
Maerua arenaria Hook. f. & Th.	..	S	*	
Cadaba indica Lam.	..	S	*	
Capparis decidua Pax	..	S	*	
„ sepiaria Linn.	..	S		*
Resedaceae.				
Ochradenus baccatus Del.	..	H	*	
Bixaceae.				
Flacourtia sepiaria Roxb.	..	S		*
Polygalaceae.				
Polygala irregularis Boiss.	..	H	*	
Caryophyllaceae.				
Polycarpaea spicata Wight & Arn.	..	H	*	
Portulacaceae.				
Portulaca oleracea Linn.	..	H	*	*
„ quadrifida Linn.	..	H	*	
Tamaricaceae.				
Tamarix Troupii Hole.	..	ST	*	
„ dioica Roxb.	..	T	*	
„ articulata Vahl.	..	ST	*	
„ indica Roxb.	..	ST		*
Elatinaceae.				
Bergia adorata Edgew.	..	H	*	
„ ammannioides Roxb.	..	H	*	
Malvaceae.				
Sida spinosa Linn.	..	H	*	
„ grewioides Guill. Perr. & A. Rich.	..	H	*	
Abutilon indicum Sir.	..	U	*	*
„ hirtum G. Don.	..	U		*
„ polyandrum W. & A.	..	U	*	

	Habit	Indus Delta	Sundri- buns
„ muticum Sw.	.. U	*	
„ fruticosum Guill. Per & A.			
Rich.	.. U	*	
Malachra capitata Linn.	.. H		*
Senra incana Cav.	.. U	*	
Hibiscus tortuosus Wall.	.. T		*
„ tiliaceus Linn.	.. T		*
Thespesia populnea Cor.	.. T	*	*
Gossypium Stocksii Mast.	.. S	*	
„ Bakeri Watt.	.. S	*	

Tiliaceae.

Grewia populifolia Vahl.	.. S	*	
„ asiatica Linn.	.. S	*	
„ villosa Willd.	.. S	*	
Triumfetta rotundifolia Lam.	.. H	*	
„ pentandra A. Rich.	.. H	*	
Corchorus antichorus Raeusch.	.. H	*	
„ tridens Linn.	.. H	*	
„ acutangulus Lam.	.. H	*	*
Brownlonia lanceolata Benth.	.. T		*

Sterculiaceae.

Melhanian Denhamii R. Br.	.. S	*	
Heritiera minor Roxb.	.. T		*
Kleinhovia hospita Linn.	.. T		*

Zygophyllaceae.

Tribulus terrestris Linn.	.. H	*	
„ alatus Del.	.. H	*	
Zygophyllum simplex Linn.	.. H	*	
Fagonia cretica Linn.	.. H	*	

Goraniaceae.

Erodium cicutarium L'Herit	.. H	*	
----------------------------	------	---	--

		Habit	Iudus Delta	Sundri buns
<i>Oxalis corniculata</i> Linn.	..	H		*
Rutaceae.				
<i>Glycosmis pentaphylla</i> Corr.	..	S		*
<i>Micromelum pubescens</i> Bl.	..	T		*
<i>Paramignya longispina</i> Hook. f.	..	U		*
<i>Aegle marmelos</i> Corr.	..	T		*
Burseraceae.				
<i>Commiphora Mukul</i> Engl.	..	S	*	
Meliaceae.				
<i>Amoora cucullata</i> Roxb.	..	T		*
<i>Carapa moluccensis</i> Lam.	..	T		*
„ <i>obovata</i> Bl.	..	T		*
Olacaceae.				
<i>Olax scandens</i> Roxb.	..	S		*
Celastraceae.				
<i>Gymnosporia montana</i> Benth	..	T		*
<i>Salacia prinoidea</i> DC.	..	ST		*
Rhamnaceae.				
<i>Zizyphus oenoplia</i> Mill.	..	S		*
„ <i>rotundifolia</i> Lam.	..	S	*	
Ampelidaceae.				
<i>Vitis quadrangularis</i> Wall.	..	S		*
„ <i>latifolia</i> Roxb.	..	S		*
„ <i>trifolia</i> Linn.	..	S		*
<i>Leea sambucina</i> Willd.	..	S		*
Sapindaceae.				
<i>Cardiospermum Halicacabum</i> Linn.	H			*
<i>Allophylus Cobbe</i> Bl.	..	S		*
<i>Phania Danura</i> Radlk.	..	S		*
Anacardiaceae.				
<i>Bouea burmanica</i> Griff.	..	T		*

	Habit	Indus Delta	Sundri- buns
Odina Wodier Roxb.	T		*
Legumin.—Papil.			
Crotalaria verrucosa Linn.	U		*
„ retusa Linn.	U		*
„ Saltiana Andr.	U		*
„ Burhia Hamilt.	U	*	
„ juncea Linn.	H	*	
„ medicaginea Lam.	H	*	
Indigofera cordifolia Heyne.	H	*	
„ uniflora Buch.	H	*	
„ anabaptista Steud.	H	*	
„ paucifolia Del.	S	*	
„ viscosa Lam.	H	*	
Tephrosia tenuis Wall.	H	*	
„ petrosa Blatt. & Hall.	H	*	
Sesbania aculeata Poir.	H	*	
Taverniera cuneifolia Arn.	U	*	
Alhagi camelorum Fisch.	S	*	
Aeschynomene indica Linn.	U	*	
„ aspera Linn.	S	*	
Alysicarpus vaginalis DC.	U	*	
Desmodium umbellatum DC.	ST		*
Abrus precatorius Linn.	S		*
Teramnus flexilis Benth.	S		*
Mucuna gigantea DC.	S		*
Erythrina indica Lam.	T		*
Canavalia lineata DC.	H		*
„ turgida Grah.	H		*
Phaseolus adenanthus Mey.	H		*
„ trilobus Ait.	H		*
Vigna luteola Benth.)	H		*

Legumin.—Papil.

<i>Atylosia scarabaeoides</i> Benth.	..	H		*
<i>Flemingia congesta</i> Roxb.	..	S		*
<i>Dalbergia spinosa</i> Roxb.	..	S		*
„ <i>torta</i> Grah.	..	S		*
<i>Rhynchosia minima</i> DC.	..	H	*	
<i>Pongamia glabra</i> Vent.	..	T	*	*
<i>Derris sinuata</i> Thw.	..	S		*
„ <i>scandens</i> Benth.	..	S		*
„ <i>uliginosa</i> Benth.	..	S		*

Legum.—Caesalp.

<i>Caesalpinia Bonducella</i> Flem.	..	S		*
„ <i>Nuga</i> Ait.	..	S		*
<i>Mezoneuron cucullatum</i> W. & A.	..	S		*
<i>Cassia Sophera</i> Linn.	..	U		*
„ <i>Tora</i> Linn.	..	H		*
<i>Cynometra mimosoides</i> Wall.	..	T		*
<i>Intsia bijuga</i> O. Kuntze.	..	T		*
<i>Entada scandens</i> , Benth.	..	S		*

Legum.—Mim.

<i>Prosopis spicigera</i> Linn.	..	H	*	*
<i>Mimosa hamata</i> Willd.	..	S	*	
<i>Acacia arabica</i> Willd.	..	T	*	
„ <i>Farnesiana</i> Willd.	..	T	*	
„ <i>Senegal</i> Willd.	..	T	*	
„ <i>tomentosa</i> Willd.	..	T		
„ <i>concinna</i> DC.	..	T		*
„ <i>Intsia</i> Willd.	..	T		*

Droseraceae.

<i>Aldrovanda vesiculosa</i> Linn.	..	H		*
------------------------------------	----	---	--	---

		Habit	Indus Delta	Sundri- buns
Rhizophoraceae.				
Rhizophora mucronata Lam.	..	T	*	*
„ conjugata Linn.	..	T	*	*
Ceriops Roxburghiana Arn.	..	T	*	*
„ Candolleana Arn.	..	T	*	
Kandelia Rheedei W. & A.	..	T		*
Bruguiera gymnorhiza Lam.	..	T	*	*
„ parviflora W. & A.	..	T		*
Combretaceae.				
Lumnitzera racemosa Willd.	..	T		*
Myrtaceae.				
Eugenia fruticosa Roxb.	..	ST		*
Barringtonia racemosa Bl.	..	T		*
„ acutangula Gaertn.	..	T		*
Lythraceae.				
Ammannia baccifera Linn.	..	H	*	
„ sp.	..	H		*
Sonneratia apetala Ham.	..	T		*
„ acida Linn. f.	..	T	*	*
Turneraceae.				
Turnera ulmifolia Linn.	..	U		*
Passifloraceae.				
Passiflora suberosa Linn.	..	H		*
Cucurbitaceae.				
Momordica Charantia Linn.	..	H	*	
Cucurbitaceae.				
Momordica dioica Roxb.	..	H		*
Trichosanthes cucumerina Linn.	..	H		*
„ palmata Roxb.	..	H		*
Luffa graveolens Roxb.	..	H		*

		Habit	Indus Sundri- Delta • buns	
<i>Cucumis trigonus</i> Roxb.	..	H		*
„ <i>prophetaurum</i> Linn.	..	H	*	
<i>Citrullus Colocynthis</i> Schrad.	..	H	*	
<i>Coccinia indica</i> W. & A.	..	H	*	
<i>Melothria maderaspatana</i> Cogn.	..	H	*	
<i>Kedrostis rostrata</i> Cogn.	..	H	*	
<i>Corallocarpus epigaeus</i> C.B. Clarke.	..	H	*	
<i>Cephalandra indica</i> Naud.	..	H		*
<i>Zehneria umbellata</i> Thw.	..	H		*
Ficoidaceae.				
<i>Sesuvium Portulacastrum</i> Linn.	..	H		*
<i>Trianthema monogyna</i> Linn.	..	H	*	*
„ <i>pentandra</i> Linn.	..	H	*	
<i>Orygia decumbens</i> Forsk.	..	H	*	
<i>Mollugo hirta</i> Thunb.	..	H	*	
Rubiaceae.				
<i>Oldenlandia diffusa</i> Roxb.	..	H		*
<i>Petunga Roxburghii</i> DC.	..	ST		*
<i>Vangueria spinosa</i> Roxb.	..	S		*
<i>Ixora parviflora</i> Vahl.	..	T		*
„ <i>coccinea</i> Linn.	..	S		*
<i>Morinda bracteata</i> Roxb.	..	T		*
Compositae.				
<i>Vernonia cinerea</i> Less.	..	H	*	*
„ <i>cinerascens</i> Schultz.	..	H	*	
<i>Ageratum conyzoides</i> Linn.	..	H		*
<i>Grangea maderaspatana</i> Poir.	..	H	*	*
<i>Conyza semi-pinnatifida</i> Wall.	..	H		*
<i>Blumea amplexans</i> DC.	..	H		*
<i>Pluchea tomentosa</i> DC.	..	H	*	

		Indus Sundr:-		
		Habit	Delta	buns
Compositae.				
„ lanceolata	C. B. Clarke.	H	*	
„ indica	Less.	H		*
Sphaeranthus	africanus Linn.	H		*
Gnaphalium	pulvinatum Del.	H	*	
Inula	grantioides Boiss.	H	*	
Vicoa	cernua Dalz. & Gibs.	H	*	
Pulicaria	angustifolia DC.	H	*	
„ Stocksii	Hook. f.	H	*	
Eclipta	erecta Linn.	H	*	
Xanthium	spinosum Linn.	H		*
Blainvillea	rhomboidea Cass.	H	*	
Wedelia	scandens C. B. Clarke.	H		*
Wedelia	calendulacea Less.	H		*
Echinops	echinatus DC.	H	*	
Volutarella	divaricata Benth. &			
Hook. f.		H	*	
Dicoma	tomentosa Cass.	H	*	
Cnicus	arvensis Hoffm.	H		*
Sonchus	oleraceus Linn.	H	*	
Launaea	chondrilloides Hook. f.	H	*	
„ nudicaulis	Hook. f.	H	*	
„ pinnatifida	Cass.	H		*
Goodeniaceae.				
Scaevola	frutescens K. Krause	S	*	
„ Plumierii	Vahl.	S	*	
Plumbaginaceae.				
Statice	Stocksii Boiss.	H	*	
Aegialitis	rotundifolia Roxb.	ST		*
Myrsinaceae.				
Aegiceras	majus Gaertn.	T	*	*

		Habit	Indus Delta	Sundri- buns
Ebenaceae.				
Diospyros montana Roxb.	..	T		*
„ Embryopteris Pers.	..	T		*
Salvadoraceae.				
Salvadora persica Linn.	..	T	*	
„ oleoides Ocne.	..	T	*	
Azima tetracantha Lam.	..	S		*
Apocynaceae.				
Cerbera Odollam Gaertn.	..	T		*
Parsonsia spiralis Wall.	..	S		*
Nerium odorum Soland.	..	S	*	
Asclepiadaceae.				
Hemidesmus indicus R. Br.	..	S		*
Finlaysonia obovata Wall.	..	S		*
Periploca aphylla Dene.	..	S	*	
„ sp.	..	S	*	
Oxystelma esculentum R. Br.	..	U	*	*
Calotropis procera R. Br.	..	S	*	
„ gigantea R. Br.	..	S		*
Pentatropis cynanchoides R. Br.	..	U	*	
„ microphylla W. & A.	..	H		*
Daemia extensa R. Br.	..	U	*	*
Sarcostemma Stocksii Hook. f.	..	S	*	
Sarcolobus globosus Wall.	..	S		*
„ carinatus Wall.	..	S		*
Dregea volubilis Benth.	..	S		*
Leptadenia Spartium Wight.	..	S	*	
Tylophora tenuis Bl.	..	H		*
Dischidia nummularia R. Br.	..	H		*
Hoya parasitica Wall.	..	S		*

	Habit	Indus Sundri-	Delta	buns
Gentianaceae.				
Enicostemma littorale Bl.	.. H	*		
Hoppea dichotoma Willd.	.. H			*
Limnanthemum cristatum Griseb.	.. H			*
Hydrophyllaceae.				
Hydrolea zeylanica Vahl.	.. H			*
Boraginaceae.				
Cordia Myxa Linn.	.. T	*		*
„ Rothii Roem, & Schult.	.. T	*		
Coldenia procumbens Linn.	.. H			*
Heliotropium indicum Linn.	.. H			*
„ ophioglossum Stocks.	.. H	*		
„ calcareum Stocks.	.. H	*		
„ ovalitolium Forsk.	.. H	*		
„ undulatum Vahl.	.. H	*		
„ paniculatum R. Br.	.. H	*		
„ rariflorum Stocks.	.. H	*		
Trichodesma indicum R. Br.	.. H	*		
Convolvulaceae.				
Stictocardia tiliaefolia Hallier. f.	.. S			*
Cressa cretica Linn.	.. H	*		
Convolvulus scindicus Stocks	.. U	*		
„ Rottlerianus Choisy.	.. U	*		
„ microphyllus Sieb.	.. U	*		
„ rhyniospermus Hochst.	.. U	*		
„ arvensis Linn.	.. H	*		
„ sp.	.. H	*		
Merremia chryseides Hallier. f.	.. H	*		
„ aegyptia Linn.	.. H	*		
„ hederacea Hallier. f.	.. S			*

		Habit	Indus Delta	Sundri- buns
<i>Ipomoea longiflora</i> R. Br.	..	S		*
„ <i>paniculata</i> R. Br.	..	S		*
„ <i>biloba</i> Forsk.	..	H	*	*
„ <i>aquatica</i> Forsk.	..	H	*	*
„ <i>illustris</i> Prain.	..	S		*
„ <i>sepiaria</i> Koen.	..	H		*
„ <i>eriocarpa</i> R. Br.	..	H	*	
<i>Rivea hypocrateriformis</i> Choisy.	..	S	*	*
<i>Cuscuta reflexa</i> Roxb.	..	H		*
Solanaceae.				
<i>Solanum nigrum</i> Linn.	..	HU	*	*
„ <i>zanthocarpum</i> Schrad & Wendl.	..	H	*	*
<i>Solanum albicaule</i> Kotschy.	..	H	*	
„ <i>xanthocarpum</i> Schrad &	..	S		*
„ <i>trilobatum</i> Linn.	..	U		*
<i>Physalis minima</i> Linn.	..	H	*	
<i>Withania somnifera</i> Dun.	..	H	*	
<i>Lycium barbarum</i> Linn.	..	S	*	
<i>Datura fastuosa</i> Linn.	..	H	*	
Scrophulariaceae.				
<i>Angelonia grandiflora</i> C. Morr.	..	H		*
<i>Linaria ramosissima</i> Wall.	..	H	*	
Scrophulariaceae.				
<i>Schweinfarthia sphaerocarpa</i> A. Braun.	..	H	*	
<i>Limnophila gratioloides</i> R. Br.	..	H	*	
„ <i>gratissima</i> Bl.	..	H		*
<i>Herpestis Monnieria</i> H.B. & K.	..	H		*
<i>Vandellia crustacea</i> Benth.	..	H		*
<i>Bonnaya veronicaefolia</i> Spreng.	..	H	*	

	Habit	Indus	Sundri-
		Delta	buns
<i>Peplidium humifusum</i> Del.	H	*	
<i>Lindenbergia abyssinica</i> Hochst.	H	*	
" <i>urticaefolia</i> Link	H	*	
<i>Scoparia dulcis</i> Linn.	H		*
Orobanchaceae.			
<i>Cistanche tubulosa</i> Wight.	H	*	
Lentibulariaceae.			
<i>Utricularia stellaris</i> Linn. f.	H		*
" <i>flexuosa</i> Vahl.	H		*
Bignoniaceae.			
<i>Tecomella undulata</i> Seem.	T	*	
<i>Dolichandrone Rheedei</i> Seem.	T		*
Acanthaceae.			
<i>Blepharis indica</i> T. Anders.	S	*	
<i>Ruellia patula</i> Jacq.	S	*	
" <i>prostrata</i> Poir.	H	*	
<i>Barleria Prionitis</i> Linn.	S	*	
" <i>acanthoides</i> Vahl.	U	*	
" <i>Hochstetteri</i> Nees.	S	*	
<i>Justicia heterocarpa</i> T. Anders.	H	*	
<i>Hygrophila quadrivalvis</i> Nees.	H		*
" <i>phlomidis</i> Nees.	H		*
" <i>spinosa</i> T. Anders.	H		*
<i>Hemigraphis hirta</i> T. Anders.	H		*
<i>Acanthus ilicifolius</i> Linn.	U		*
" <i>volubilis</i> Wall.	U		*
Verbenaceae.			
<i>Lantana indica</i> Roxb.	S		*
" <i>trifolia</i> Linn.	S		*
<i>Lippia geminata</i> H. B. & K.	S		*
" <i>nodiflora</i> Rich.	H	*	*

		Habit	Indus Delta	Sundri- buns
Premna integrifolia Linn.	..	ST		*
Vitex trifolia Linn. f.	..	ST		*
„ Negundo Linn.	..	ST		*
Clerodendron Phlomidis Linn. f.	..	S	*	
„ inerme Gaertn.	..	U		*
„ neriifolium Wall.	..	U		*
„ Siphonanthus R. Br.	..	S		*
Avicennia officinalis Linn.	..	T	*	*
„ alba Bl.	..	S		*
Labiatae.				
Ocimum sanctum Linn.	..	HU	*	*
„ canum Sims.	..	HU	*	
Ocimum basilicum Linn.	..	H		*
Anisomeles ovata R. Br.	..	H		*
Leucas urticaefolia R. Br.	..	H	*	
„ linifolia Spreng.	..	H		*
Salvia aegyptiaca Linn.	..	H	*	
Nyctaginaceae.				
Boerhaavia diffusa Linn.	..	H	*	
„ verticillata Poir.	..	H	*	
Amarantaceae.				
Celosia argentea Linn.	..	H	*	
Digera arvensis Forsk.	..	H	*	
Amarantus viridis Linn.	..	H	*	*
„ polygamus Linn.	..	H	*	
Acrua tomentosa Forsk.	..	H	*	
„ pseudo-tomentosa Blatt.	&			
„ Hall.	..	H	*	
Achyranthes aspera Linn.	..	H	*	
Nothosaerua brachiata Wight	..	H	*	
Pupalia lappacea Moq.	..	H	*	

		Indus Sundri-		
		Habit	Delta	buns
<i>Psilotrichum ferrugineum</i> Moq.	.. H		*	
<i>Alternanthera triandra</i> Lam.	.. H	*	*	
„ <i>nodiflora</i> Br.	.. H	*		
Chenopodiaceae.				
<i>Chenopodium murale</i> Linn.	.. H	*		
<i>Atriplex Stocksii</i> Boiss.	.. H	*		
<i>Arthrocnemum indicum</i> Moq.	.. U	*	*	
<i>Salicornia brachiata</i> Roxb.	.. U		*	
<i>Suaeda fruticosa</i> Forsk.	.. S	*		
„ <i>nudiflora</i> Moq.	.. U	*		
„ <i>monoica</i> Forsk.	.. U	*		
„ <i>Maritima</i> Dumort.	.. H		*	
<i>Haloxylon recurvum</i> Bunge.	.. S	*		
<i>Salsola foetida</i> Del.	.. S	*		
<i>Basella rubra</i> Linn.	.. H		*	
Polygonaceae.				
<i>Polygonum plebejum</i> R. Br.	.. H	*		
Aristolochiaceae.				
<i>Aristolochia bracteata</i> Retz.	.. H	*		
„ <i>indica</i> Linn.	.. U		*	
Lauraceae.				
<i>Cassytha filiformis</i> Linn.	.. H		*	
Loranthaceae.				
<i>Loranthus Scurrula</i> Linn.	.. S		*	
„ <i>longiflorus</i> Desr.	.. S		*	
„ <i>globosus</i> Roxb.	.. S		*	
<i>Viscum monoicum</i> Roxb.	..			
Euphorbiaceae.				
<i>Euphorbia caducifolia</i> Ham.	.. S		*	
„ <i>hypericifolia</i> Linn.	.. S	*		
„ <i>hirta</i> Linn.	.. H	*	*	

		Indus Sundri- Habit Delta buns		
	„ pilulifera Linn.	.. H	*	
	„ granulata Forsk.	.. H	*	*
Euphorbiaceae.				
	Euphorbia Clarkeana Hook. f.	.. H	*	
	„ jodhpurensis Blatt. & Hall	.. H	*	
	„ thymifolia Burm.	.. H		*
	Andrachne aspera Spreng.	.. H	*	
	„ sp. nov.	.. H	*	
	Bridelia stipularis Bl.	.. S		*
	Agynenia bacciformis A. Juss.	.. HU		*
	Phyllanthus reticulatus Poir.	.. S	*	
	„ Niruri Linn.	.. H	*	*
	Breynia rhamnoides Muell.-Arg.	.. ST		*
	Cyclostemon assamicus Hook. f.	.. T		*
	Antidesma Ghaesembilla Gaertn.	.. T		*
	Croton oblongifolius Roxb.	.. T		*
	Chrozophora plicata A. Juss.	.. HU		*
	Acalypha indica Linn.	.. H		*
	Trewia nudiflora Linn.	.. T		*
	Mallotus repandus Muell.-Arg.	.. S		*
	Sapium indicum Willd.	.. T		*
	Excoecaria Agallocha Linn.	.. T		*
Urticaceae.				
	Trema orientalis Bl.	.. T		*
	Streblus asper Lour.	.. ST		*
	Ficus retusa Linn.	.. T		*
	„ infectoria Roxb.	.. T		*
	„ Rumphii Bl.	.. T		*
	„ religiosa Linn.	.. T		*
	„ glomerata Roxb.	.. T	*	

Indus Sundri-
Habit Delta buns

Casuarinaceae.

Casuarina equisetifolia Forst. .. T *

Salicaceae.

Populus euphratica Oliv. .. T *

Ceratophyllaceae.

Ceratophyllum demersum Linn. .. H *

Gnetaceae.

Ephedra foliata Boiss. .. S *

Hydrocharitaceae.

Hydrilla verticillata Casp. ... H *

Vallisneria spiralis Linn. ... H * *

Lagarosiphon Roxburghii Benth. ... H *

Ottelia alismoides Pers. ... H *

Orchidaceae.

Oberonia Gammiei King & Pantling. H *

Dendrobium anceps Sw. ... H *

„ * Pierardi Roxb. ... H *

Cirrhopetalum Roxburghii Lindl. ... H *

Trias oblonga Lindl. ... H *

Luisia teretifolia Gaud. ... H *

„ brachystachys Bl. ... H *

Saccolabium ochraceum Lindl. ... H *

Orchidaceae.

Saccolabium longifolium Hook. f. ... H *

„ papillosum Lindl. ... H *

Saracanthus appendiculatus Hook. f. - H *

Saracanthus insectifer Reichb. ... H *

Cleisostoma ramosum Hook. f. ... H *

Indus Sundri-
Habit Delta buns

Scitamineaceae.

Alpinia Allughas Roscoe.	..	H		*
Zingiber Casumunar Roxb.	..	H		*

Amaryllidaceae.

Crinum asiaticum Linn.	..	H	*	*
------------------------	----	---	---	---

Disoscoriaceae.

Dioscorea pentaphylla Linn.	..	H		*
-----------------------------	----	---	--	---

Liliaceae.

Asphodelus tenuifolius Cav.	..	H		*
Asparagus gharoensis Blatter.	..	S	*	
„ dumosus Baker.	..	S	*	
„ deltae Blatter.	..	S	*	

Commelinaceae.

Commelina benghalensis Linn.	..	H		*
„ albescens Hassk.	..	H	*	
Aneilema nudiflorum R. Br.	..	H		*

Flagellariaceae.

Flagellaria indica Linn.	..	S		*
--------------------------	----	---	--	---

Palmae.

Nipa fruticans Wurmb.	..	T		*
Phoenix paludosa Roxb.	..	T		*
Calamus tenuis Roxb.	..	S		*
Daemonorops Jenkinsianus Mart.	..	S		*
Cocos nucifera Linn.	..	T	*	*

Pandanaceae.

Pandanus tectorius Soland.	..	S	*	*
„ fotidus Roxb.	..	S		*

Typhaceae.

Typha angustata Bory & Chaub.	..	H	*	*
„ elephantina Roxb.	..	H	*	*

		Indus	Sundri-
	Habit	Delta	buns
Araceae.			
Cryptocoryne ciliata Fisch.	..	H	*
Pistia stratiotes Linn.	..	H	*
Lemnaceae.			
Lemna sp.	..	H	*
Alismaceae.			
Sagittaria sagittifolia Linn.	..	H	*
Naiadaceae.			
Ruppia rostellata Koch.	..	H	*
Zanichellia palustris Linn.	..	H	*
Naias minor All.	..	H	*
„ sp.	..	H	*
„ sp.	..	H	*
Aponogeton monostachyum Linn.	..	H	*
Cyperaceae.			
Kyllingia triceps Rottb.	..	H	*
Pycnus polystachus Beauv.	..	H	*
Cyperus inundatus Roxb.	..	H	*
„ malaccensis Lam.	..	H	*
„ tegetiformis Roxb.	..	H	*
„ scariosus R. Br.	..	H	*
„ exaltatus Retz.	..	H	*
Cyperaceae.			
Cyperus stoloniferus Retz.	..	H	*
„ alopecuroides Rottb.	..	H	*
„ Haspan Linn.	..	H	*
„ arenarius Retz.	..	H	*
„ tegetum Roxb.	..	H	*
„ rotundus Linn.	..	H	*
Mariscus albescens Gaud.	..	H	*

		Indus Sundri-	
		Habit Delta	buns
<i>Eleocharis spiralis</i> Kunth.	.. H		*
„ <i>atropurpureus</i> Kunth.	.. H	*	
<i>Fimbristylis ferruginea</i> Vahl.	.. H	*	*
<i>Fimbristylis polytrichoides</i> Vahl.	.. H		*
„ <i>sub-bispicata</i> Nees & Meyen	.. H		*
„ <i>monostachya</i> Hassk.	.. H		*
„ <i>dichotoma</i> Vahl.	.. H	*	
<i>Scirpus quinquefarius</i> Ham.	.. H	*	
„ <i>maritimus</i> Linn.	.. H	*	
„ <i>grossus</i> Linn. f.	.. H		*
„ <i>littoralis</i> Schrad.	.. H		*
„ <i>triqueter</i> Linn.	.. H		*
„ <i>articulatus</i> Linn.	.. H		*
<i>Cladium riparium</i> Benth.	.. H		*
<i>Scirpodendron costatum</i> Kurz.	.. H		*
Gramineae.			
<i>Imperata arundinacea</i> Cyrill.	.. H		*
<i>Coix Lachyma-Jobi</i> Linn.	.. H	*	
<i>Hemarthria compressa</i> R. Br.	.. H	*	
<i>Saccharum spontaneum</i> Linn.	.. H	*	*
„ <i>Griffithii</i> Munro.	.. H	*	
„ <i>Ravennae</i> Linn.	.. H	*	
<i>Vetiveria zizanoides</i> Stapf.	.. H	*	*
<i>Amphilophis glabra</i> Stapf.	.. H		*
<i>Chrysopogon aciculatus</i> Trin.	.. H		*
<i>Dichanthium annulatum</i> Stapf.	.. H	*	
<i>Cymbopogon Jwarancusa</i> Schult.	.. H	*	
<i>Digitaria sanguinalis</i> Scop.	.. H	*	
„ <i>pennata</i> Chiov.	.. H	*	
<i>Eriochloa ramosa</i> Kuntze.	.. H	*	*

Gramineae.

Paspalum scrobiculatum Linn.	..	H	*	*
„ vaginatum Sw.	..	H		*
Urochloa reptans Stapf.	..	H		*
„ setigera Stapf.	..	H	*	
Paspalidium geminatum Stapf.	..	H	*	
Echinochloa colona Link.	..	H	*	*
„ Crus-Galli P. Beauv.	..	H	*	*
Echinochloa stagnina P. Beauv.	..	H	*	
Setaria lutescens Hubb.	..	H		
„ verticillata Beauv.	..	H	*	*
Chamaeraphis spinescens Poir.	..	H		*
Panicum antidotale Retz.	..	H	*	
„ proliferum Lam.	..	H		*
„ repens Linn.	..	H		*
„ Myurus H. B. K.	..	H		*
Pennisetum cenchroides Rich.	..	H	*	
Cenchrus biflorus Roxb.	..	H	*	
„ catharticus Del.	..	H	*	
Phragmites karka Trin.	..	H	*	*
Sporobolus arabicus Boiss.	..	H	*	
„ tremulus Kunth.	..	H		*
Heleochloa dura Boiss.	..	H	*	
Aristida Adscensionis Linn.	..	H	*	
„ funiculata Trin.	..	H	*	
Tragus racemosus Scop.	..	H	*	
Desmostachya cynosuroides Stapf.	..	H	*	
Eragrostis-ciliaris Link.	..	H	*	
„ amabilis Wight & Arn.	..	H	*	
„ interrupta Beauv.	..	H	*	
„ tenella R. & S.	..	H	*	

		Indus	Sundri-
	Habit	Delta	buns
<i>Diplachne fusca</i> Beauv.	.. H	*	*
<i>Chloris villosa</i> Pers.	.. H	*	
„ <i>barbata</i> Sw.	.. H	*	*
<i>Cynodon dactylon</i> Pers.	.. H	*	
<i>Eleusine flagellifera</i> Nees.	.. H	*	
„ <i>aristata</i> Ehrenb.	.. H	*	
„ <i>aegyptiaca</i> Desf.	.. H	*	*
„ <i>indica</i> Gaertn.	.. H		*
<i>Oryza coarctata</i> Roxb.	.. H	*	*
<i>Leersia hexandra</i> Sw.	.. H		*
<i>Zoysia pungens</i> Willd.	.. H		*
<i>Aeluropus villosus</i> Trin.	.. H	*	
<i>Myriostachya Wightiana</i> Hook. f.	.. H		*

CHAPTER XXXVII

MANGROVES

There is one important class of plants, the so-called Mangroves, which we should like to consider separately. Many data of the following list are taken from Troup, *Silviculture of Indian Trees*, the rest from Gamble's and Haines' Floras.

	Indus	Delta.	W. Coast.	E. Coast.	Sundribuns.	Chittagong.	Burma.	Andamans.
Rhizophor.								
<i>Rhizophora mucronata</i> Lam.	..	*	*	*	*	*	*	*
„ <i>conjugata</i> Linn.	..	*	*	*	...	*	*	*

	Indus Sundri-
	Habit Delta buns
Ceriops Candolleana Arn.	.. * * ... * *
„ Roxburghiana Arn.	.. * * * * * * ...
Khandelia Rheedei W. & A. * * * * * *
Bruguiera gymnorhiza Lam.	.. * * * * * * *
„ eriopetala W. & A.	... * * *
„ caryophylloides Bl.	... * * *
„ parviflora W. & A. * ..
Meliac.	
Carapa obovata Bl.	... * * * * * *
„ moluccensis Lam. *
Leguminos.	
Cynometra ramiflora Linn.	... * * * * * *
Combretac.	
Lumnitzera racemosa Willd.	... * * * * * *
„ coccinea W. & A. * *
Lythrac.	
Sonneratia acida Linn. f.	* * * * * * *
„ apetala Ham. * * * * ..
„ alba Sm.	... *
„ Griffithii Kurz. * ..
Rubiace.	
Scyphiphora hydrophyllacea Gaertn. *
Myrsinac.	
Aegiceras majus Gaertn.	* * * * * *
Acanthac.	
Acanthus ilicifolius Linn.	... * * * * * ..
Verbenac.	
Avicennia officinalis Linn.	* * * * * *
„ alba B.C. *
„ marina Vierh. *

Indus Sundri-
Habit Delta buns

Euphorbiac.

Excoecaria agallocha Linn.

... * * * * *

Palmae.

Nipa fruticans Wurmbr.

... .. * * * * *

Phoenix paludosa Roxb.

... .. * * * * *

8 17 21 17 16 21 18